Fidalgo Bay Aquatic Reserve Management Plan

June 2019 DRAFT

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

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Fidalgo Bay Aquatic Reserve Management Plan

Washington State Department of Natural Resources

Aquatic Resources Division

June 2019

Executive Summary

The Fidalgo Bay Aquatic Reserve was established in 2000 as an environmental reserve to protect the special character, habitats and species of the area. Fidalgo Bay is a shallow embayment supporting extensive mudflats and eelgrass beds southeast of Anacortes, Washington. As of 2019, the reserve includes approximately 780 acres of tidelands and bedlands. The Skagit Land Trust holds a conservation easement on 532 acres of the reserve.

This plan identifies conservation elements in the Fidalgo Bay Aquatic Reserve and management strategies implemented by the Washington State Department of Natural Resources (DNR) and partners. The intent of the plan is to conserve these resources with an emphasis on environmental protection above all other actions.

DNR will not approve new uses in the reserve with the exception of research and monitoring, restoration, environmental education, and public access, where consistent with the purpose and goals of the reserve. DNR management authority extends only to the state-owned aquatic lands; and therefore this plan does not apply to privately owned tidelands or upland property.

The following management goals are established for the Fidalgo Bay Aquatic Reserve:

1) **Natural functions and processes**: Protect, enhance and restore the natural functions and processes of nearshore ecosystems.
2) **Native habitats and species**: Conserve and enhance native aquatic habitats and species with an emphasis on conservation priorities.
3) **Monitoring and research**: Gather and assess ecological and human use information to support adaptive management decisions.
4) **Environmental education, stewardship, and partnerships**: Promote stewardship of the aquatic reserve by facilitating environmental education and citizen science, strengthening community partnerships, and promoting public use.
5) **Authorized uses**: Authorized uses on state-owned aquatic lands must be consistent with the aquatic reserve long-term vision and management goals and the conservation easement.

Specific objectives and strategies to accomplish the reserve goals are outlined in Section 5—Management Guidance.

The first management plan was prepared in 2008. Since management plans are intended to be reviewed and updated every ten years throughout the 90-year term of the reserve designation, the 2019 edition contained here is the first ten-year update for Fidalgo Bay. Changes in ecosystem condition and existing uses of state-owned aquatic lands since the establishment of the reserve are included in this update. The most current research and monitoring data will be used to evaluate how well management strategies are meeting the goals and objectives of the reserve. Through adaptive management, strategies will be modified and improved to best achieve the plan goals.

This updated plan draws upon existing data and other scientific information about the aquatic resources at the site, integrating a number of new studies and reports from the past ten years. An enthusiastic group of interested stakeholders, including local and state government, the Samish

Indian Nation, the Swinomish Tribal Community, non-profit organizations, local citizen scientists, and industry was convened in October 2018 to begin the update process. Their ideas regarding how to promote the conservation of aquatic resources and ecosystem health at the site helped develop and improve this plan update.

Figure 1: Great Blue Heron, an iconic species of the reserve (*Photo: Ron Holmes*).

Table of Contents

List of Acronyms

CSC	Citizen Stewardship Committee
Corps	U.S. Army Corps of Engineers
DNR	Washington State Department of Natural Resources
DOH	Washington State Department of Health
DOT	Washington State Department of Transportation
DVRP	DNR Derelict Vessel Removal Program
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
MLLW	Mean Lower Low Water
NOAA	National Oceanographic and Atmospheric Administration
OFM	Washington State Office of Financial Management
PSC	Puget SoundCorps
PSP	Puget Sound Partnership
RCW	Revised Code of Washington
SVMP	DNR Submerged Vegetation Monitoring Program
SEPA	State Environmental Policy Act
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WSDA	Washington State Department of Agriculture

1. Introduction

Washington's Department of Natural Resources

The Washington State Department of Natural Resources (DNR) Aquatic Resources Division manages about 2.6 million acres of state-owned aquatic lands. This includes 64,000 acres of tidelands, 32,000 acres of shorelands, and 2.46 million acres of marine and freshwater bedlands. In addition, there are approximately 13,000 acres of other aquatic lands, such as Harbor Areas, waterways and abandoned lands, that fall under DNR management.

DNR is directed by the Revised Code of Washington (RCW) to manage state-owned aquatic lands to provide a balance of public benefits that include encouraging public access, fostering water-dependent use and access, ensuring environmental protection, and utilizing renewable resources. In addition, DNR is directed to generate revenue from state-owned aquatic lands when it is consistent with the other public benefits. DNR manages the state's sensitive aquatic lands and when necessary, removes them from conflicting uses. As part of this authority, under Washington Administrative Code (WAC) 332-30-151, DNR can establish environmental, scientific, and educational aquatic reserves on state-owned aquatic lands. The Fidalgo Bay Aquatic Reserve was established as an environmental aquatic reserve in 2000, and confirmed as a reserve candidate in 2003. This management plan update began in 2018 and was completed in early 2019.

Aquatic Reserves Program

DNR established the Aquatic Reserves Program to promote preservation, restoration, and enhancement of important native ecosystems on state-owned aquatic lands.

The successful record of accomplishment demonstrated in Aquatic Reserve management helps ensure that reserves are proposed, reviewed and designated in a fair and transparent process, and conserve the most important aquatic resources. Successful long-term management of aquatic reserves depends upon a fair and transparent process for proposing, designating, and planning for management actions in reserves to conserve the most important aquatic resources statewide.

Three types of aquatic reserves may be established through the Aquatic Reserves Program: environmental, scientific, or educational. The objectives for each reserve category can be found in the *Aquatic Reserve Program Implementation and Designation Guidance*, on DNR's webpage www.dnr.wa.gov.

DNR and its partners manage each reserve in a manner consistent with the goals for the type of reserve established and site-specific management plans.

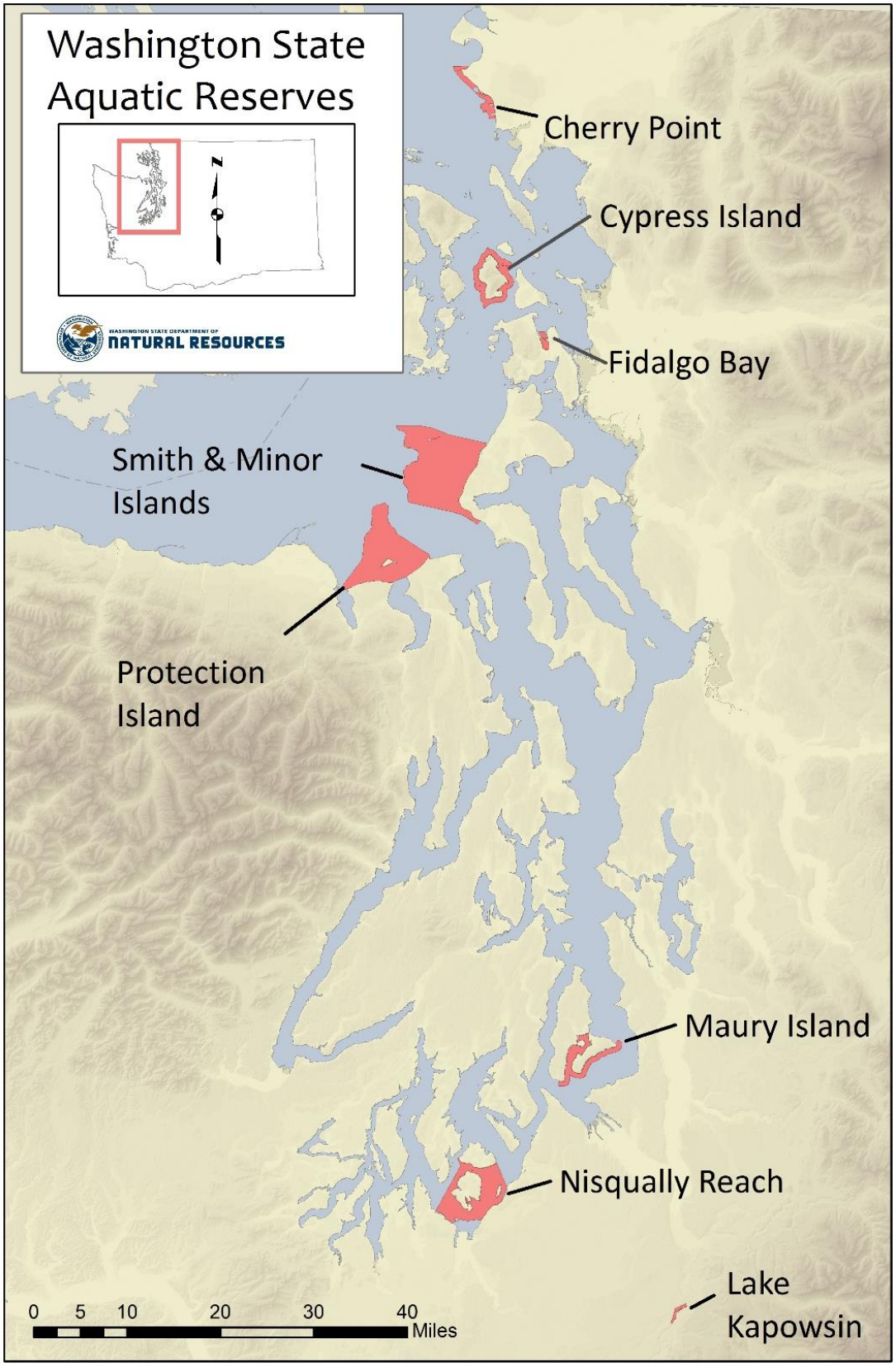

Figure 2: Washington State Aquatic Reserves.

Legal Authorities for Establishing State Aquatic Reserves

One of DNR's primary directives for the management of state-owned aquatic lands is RCW 79.105.030, which identifies environmental protection as the overarching goal of the Aquatic Reserves Program. WAC 332-30-151 directs DNR to consider lands with educational, scientific, and environmental values for aquatic reserve status, and identifies management guidelines for aquatic reserves. WAC 332-30-106(16) defines environmental reserves as sites of environmental importance, which are established for the continuance of environmental baseline monitoring and/or areas of historical, geological, or biological interest requiring special protective management. RCW 79.10.210 further authorizes DNR to identify and withdraw from all conflicting uses public lands that can be utilized for their natural ecological systems. DNR does not acquire properties to establish reserves; they are designated on existing state-owned aquatic lands or donated aquatic lands.

Fidalgo Bay Aquatic Reserve

The Fidalgo Bay Aquatic Reserve encompasses approximately 780 acres of state-owned tidelands and bedlands. The reserve boundaries extend from the southern end of Fidalgo Bay north to a line drawn east and west from Crandall Spit (Figure 3). The reserve was established to protect important conservation elements such as large eelgrass beds, forage fish spawning beaches, intertidal and important bird habitat. Section 2 of this plan (Ecosystem Description, Human Impacts and Stressors) provides a thorough geographic, physical and biological description of the Fidalgo Bay Aquatic Reserve. It provides the background material to support identified conservation elements and management objectives.

Legal Boundaries

A description of the legal boundaries of the reserve is included in DNR's Withdrawal Order (Appendix E). The Order, signed by the Commissioner of Public lands, withdrawals aquatic lands from all uses except those specified in the Order.

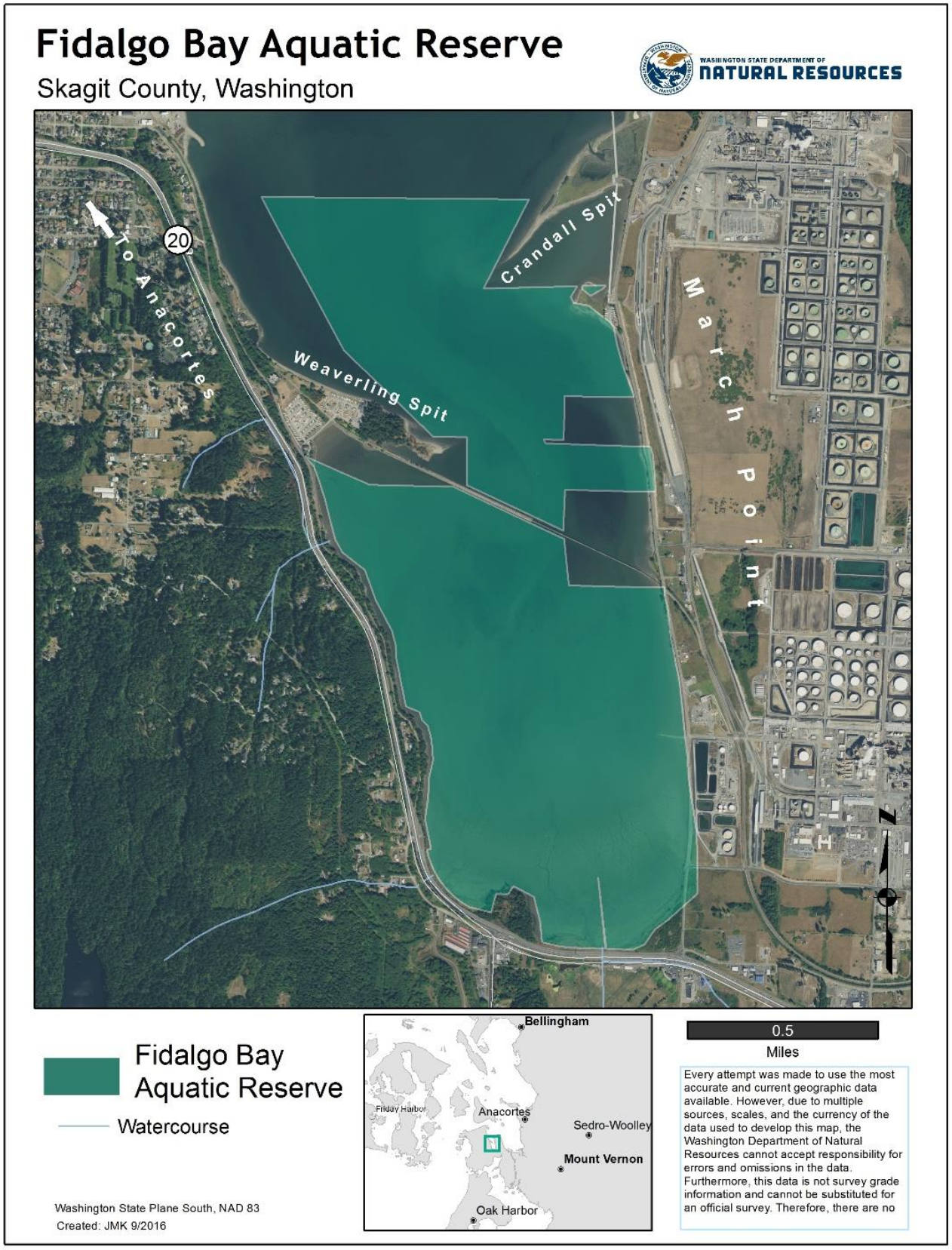

Figure 3: Fidalgo Bay Aquatic Reserve Boundary.

Purpose of the Fidalgo Bay Aquatic Reserve Management Plan

This plan describes the habitats and species identified for conservation in the aquatic reserve and the actions that will be taken to protect these resources. The management emphasis will place protection of these resources as the highest priority. Community and regional interests and values are important for the long-term existence and support for the reserve and are recognized as essential elements of the plan as well.

The Fidalgo Bay Aquatic Reserve Management Plan has been developed in accordance with the State Environmental Policy Act. This plan will serve as DNR's primary management guidance for the 90-year term of the reserve. The plan lays out the goals, objectives and strategies for managing the reserve, and is updated every ten years to reflect current conditions.

Decision making and planning regarding management of the aquatic reserve will be guided primarily by information and content from the following three sections of this plan:

- **Section 2: Ecosystem Description, Human impact and Stressors:** This serves as an introduction to the site. Resource characteristics are identified and current ecological conditions are described for the site. Potential impacts and data gaps are also identified in this section.
- **Section 5: Management Guidance**: This section identifies the desired future ecological conditions. Goals and objectives are also identified that will aide in the site management decision making. Strategies are outlined for implementing the goals.
- **Section 6: Implementation Guidance**: This section introduces the process for ongoing decision making, local involvement and inclusion of a wide range of participants.

Plan Updates and Adaptive Management

This is the first update of the plan following adoption of the original management plan in 2008. Every ten years, the plan is reviewed and updated with current scientific, management, and site-specific information. During the development of each update, DNR works with partners and stakeholders to establish cooperative management for activities within and adjacent to the reserve. These activities will conserve, enhance and restore habitats and species within the reserve, and support public access and education.

DNR intends to manage the reserve using a process called Collaborative Adaptive Management[1]. This is a structured process of decision making in the face of uncertainty, with an aim to reduce uncertainty over time via system monitoring. Collaborative Adaptive Management helps DNR integrate changes in scientific knowledge concerning the site, conditions of habitats and species, and uses of state-owned aquatic lands. Knowledge gained from research and monitoring activities provides objective data about how well management actions are meeting goals and objectives for the reserve. This process improves site management through learning about the system, using results from data generated by DNR and local partners to evaluate management actions and develop new strategies. For instance, data on forage fish spawning sites can be used to evaluate whether restoration work is increasing egg survival, or spawning areas are expanding. In the past ten years, significant studies were completed that provide science-based information to support management

[1] Williams, B. K., and E. D. Brown. 2012. Adaptive Management: The U.S. Department of the Interior Applications Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

actions in the upcoming ten-year period. Monitoring is ongoing that will provide information about the effects, and success of various restoration projects that are completed or envisioned.

By establishing a stronger process to engage stakeholders and partners during the 2018–2019 management plan update, DNR will support the collaborative aspect of adaptive management. The management plan will be regularly updated, as needed, throughout the 90-year term of the reserve designation. DNR will include new scientific results in plan updates, and new inclusions and adaptations will not be restricted to every 10 years. Plan updates will be posted on the aquatic reserves webpage and emailed to the stakeholder group.

Important Conservation Elements

The Fidalgo Bay Aquatic Reserve is established to protect and conserve key elements of the natural environment and preserve valued ecosystem goods and services, listed in Table 1 below.

Protecting, enhancing and restoring these elements will be the focus of conservation efforts and management actions in the reserve. Managing the complexity of this ecosystem and its many values to the community require a broad array of expertise that is reflected in the plan's emphasis on collaboration. We continually refer to the important conservation elements as we prioritize areas of focus for research, monitoring, and resulting actions.

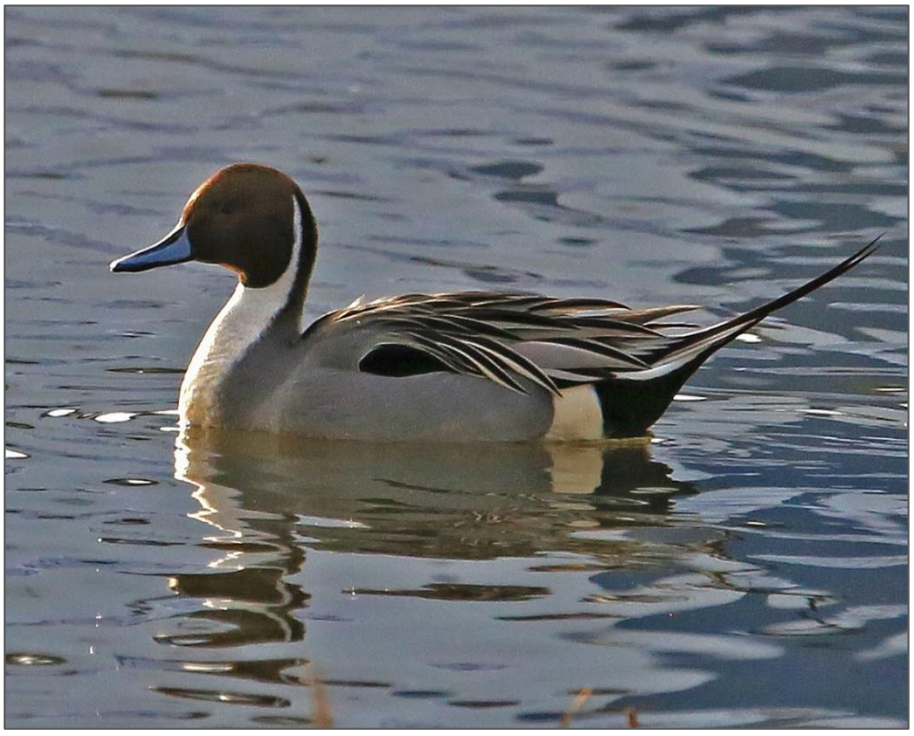

Figure 4. Northern Pintail *(Photo: Ron Holmes).*

Table 1. Important Conservation Elements for the Fidalgo Bay Aquatic Reserve.

Category	Conservation Element	Description
Physical Processes	Hydrologic processes	Freshwater inputs to the bay, tidal exchange, the amount of flushing, and other functions that are unimpeded by structures and modifications.
	Sediment movement	Critical functions of healthy nearshore habitat areas are supported by sediment drift cells on beaches with minimal armoring. Restoration is essential to maintain, enhance or restore natural functions and habitat.
Habitats and Communities	Submerged Aquatic Vegetation	Extensive native eelgrass beds (*Zostera marina*) provide complex structural and biological habitat for many species, including spawning, nursery, refuge, and foraging areas for juvenile and adult fishes and birds.
		Understory kelps, macroalgae and emergent saltmarsh vegetation support primary productivity and structural and biological habitat for spawning, nursery, and foraging juvenile and adult fishes, invertebrates, and birds.
	Tide flats, intertidal nearshore	The intertidal zone and large mudflats support diverse habitats for resting and foraging birds, juvenile fishes, crabs, numerous small crustaceans, and invertebrate species. It functions as a storm buffer, minimizing flooding and facilitating water absorption; water temperatures warm earlier and retain heat; detritus, carbon, nutrients are retained; and contaminants are taken up.
	Beaches that support spawning habitat	Shorelines with upper intertidal areas of mixed sand, and fine gravels, particularly depositional features such as the spits, provide critical habitat for forage fish spawning and foraging birds.
Species	Surf smelt and Pacific sand lance	Forage fish provide a food source for many seabirds, salmon, and marine mammals. Surf smelt are the most prevalent species of forage fish in the bay and spawn year-round. Spawning is prolific on beaches north of the trestle with a well-documented climax in the summer.
	Pacific herring	Although, spawning has declined precipitously in recent years in Fidalgo Bay and throughout the region, broad year-to-year fluctuations are typical of Pacific herring. Preserving and optimizing available spawning habitat areas continues to be a priority in the reserve.
	Juvenile salmonids	The reserve provides refuge and forage areas for juvenile salmon. Coho salmon, Chinook salmon, Pink, and Chum Salmon utilize the bay as migratory corridors and rearing area.

Category	Conservation Element	Description
	Waterbirds[2]	The reserve is an important wintering and migratory waterbird area, providing shallow protected waters and foraging areas. Seasonal and migratory waterbirds include geese, grebes, loons, scoters, diving and dabbling ducks, terns and gulls. Resident birds include Great Blue Heron, Bald Eagle, Osprey, and several species of cormorant.
	Olympia oysters	Native Olympia oysters are thriving in Fidalgo Bay following a series of ongoing reintroductions. Oysters provide many ecosystem services including 3-dimensional structural habitat, increased biodiversity, local harvest of cultured or wild food, and as filter feeders, maintaining or improving water quality.
Valued Cultural Features	Public values for Tommy Thompson Trail	The everyday value and use of the trail is integrated into community life as a cornerstone recreational and transportation feature. The trail provides access, fosters nature education, and enjoyment of Fidalgo Bay with unimpeded views of the surrounding aquatic reserve.
	Weaverling Spit	The Samish Indian Nation is committed to maintaining the cultural, historical and ecological benefits and opportunities provided by Weaverling Spit. Inclusive community use and public benefit is promoted through scientific, educational, and recreational activities. This centrally located feature is a cornerstone value for the community and aquatic reserve.
	Traditional uses – shellfish harvest	Shellfish resources are a valued traditional food source for local native tribal communities. A healthy, tribally controlled harvest of shellfish in parts of the bay can assure the sustainability of shellfish resources. Continued monitoring and possibly enhancement will aid in maintaining a viable population in the bay.
	Aesthetics – Scenic Beauty	Public access to water views, wildlife, and restored shorelines that recognizes and emphasizes the importance of scenic beauty.

[2] Waterbirds. For this plan, the term *waterbird* is used to describe birds that occupy and use shallow inland marine bays and salt marsh habitats. These include marine diving ducks and alcids, shorebirds of all kinds, dabbling ducks, gulls, and brants geese.

Relationship to Federal, State, Local, and Tribal Management

The successful management of the Fidalgo Bay aquatic reserve requires coordination and collaboration with public and private entities as well as local, state, federal, and Tribal government, and non-government organizations. The following provides information regarding ongoing management interests at or near Fidalgo Bay.

Tribal Interests at Fidalgo Bay

The following Tribes have asserted a claim to usual and accustomed areas in Fidalgo Bay:

1. Lummi Nation
2. Nooksack Indian Tribe
3. Suquamish Tribe
4. Tulalip Tribes
5. Swinomish Indian Tribal Community

In addition, the Samish Indian Nation owns 40 acres of tidelands and 30 acres of upland properties on Weaverling Spit. The Samish Nation has historic and cultural ties to Fidalgo Bay and the surrounding area and has expressed a strong interest in restoration of forage fish spawning habitat, improving water quality, restoration of native shellfish populations and restoration of natural shoreline processes in Fidalgo Bay.

The Swinomish Indian Tribal Community owns 26 acres of tidelands adjacent to the eastern shore of the reserve and March Point Road. This community also has historic and cultural ties to Fidalgo Bay, March Point, and the surrounding area. The Swinomish Tribe has completed several nearshore restoration projects in and around Fidalgo Bay.

Conservation goals and management activities identified in this management plan are not meant to conflict with Tribal treaty, natural resource, or cultural interests. DNR will continue to engage in a government-to-government dialog with the Tribes to ensure that treaty rights are upheld, and that historical and cultural ties to Fidalgo Bay are maintained**.**

Washington Department of Fish and Wildlife

The Department of Fish and Wildlife (WDFW) is dedicated to preserving, protecting, and perpetuating the state's fish, wildlife, and ecosystems while providing sustainable fish and wildlife recreational and commercial opportunities. The agency has primary responsibility for regulating fishing and hunting including within aquatic reserves. WDFW staff are key partners in research projects on aquatic reserves, and DNR shares essential monitoring data with WDFW.

Washington Department of Ecology

The mission of the Department of Ecology is to protect, preserve, and enhance the environment for current and future generations. The agency is responsible for regulating air, water, and sediment quality, toxic waste, and spill prevention and response. Ecology has also played a lead role in shoreline and intertidal cleanup in and near Anacortes, with adjacent benefit to the reserve.

Padilla Bay National Estuarine Research Reserve

The Padilla Bay National Estuarine Research Reserve was designated in 1980 and is located approximately 3 miles east of Fidalgo Bay Aquatic Reserve. It is one of 27 reserves in the National

Estuarine Research Reserve System, established to provide for research and education about estuaries around the coastal United States and Puerto Rico. The Padilla Bay Reserve offers educational programs for school groups and the general public, monitors natural resources and promotes research in Padilla Bay. Volunteer and professional training that benefits Fidalgo Bay is often held at the Padilla Bay facility. The National Estuarine Research Reserve program is jointly-administered by the U.S. Department of Commerce, N.O.A.A. Office of Coastal Resource Management, Estuarine Reserves Division, and the Washington State Department of Ecology.

The Padilla Bay Reserve encompasses 11,000 acres, 7,500 of which are eelgrass meadows, important nursery areas for juvenile fish and crab, as well as feeding areas for migratory shorebirds and waterfowl, such as the black brant goose. Padilla Bay itself is considered an "orphaned" estuary, cut off from its major freshwater sources by conversion of salt marshes to agricultural land in the late 1800s and early 1900s. Many of the shore birds and waterfowl known to occur in Padilla Bay also can be found in Fidalgo Bay. In addition, the close proximity between Fidalgo Bay and Padilla Bay provides good habitat connectivity for several species of out-migrating juvenile salmonids.

Cypress Island Aquatic Reserve

DNR established the Cypress Island Aquatic Reserve in 2000 and adopted a management plan for this site in 2007. The reserve is located about 6 miles northwest of Fidalgo Bay Aquatic Reserve in the extreme northwest corner of Skagit County. The site contains a diverse assemblage of habitats and species including; rocky reefs, eelgrass and kelp beds, pocket beaches, rocky shorelines, abalone, sea urchins, scallops, sea cucumbers, crabs, reef dwelling and demersal ground fish, salmon and forage fish.

The close proximity of the Cypress Island Aquatic Reserve to the Fidalgo Bay Aquatic Reserve may provide some level of habitat connectivity for those species that are found at both sites, such as forage fish, salmon, crabs and marine birds.

Hat Island NRCA

Hat Island Natural Resource Conservation Area (NRCA) is one of the eastern most islands in the San Juan group, located about 2.5 miles northeast of the Fidalgo Bay aquatic reserve. The 91–acre island contains Douglas-fir, Pacific madrone and Pacific yew dominant forests, and grass headlands composed of blue wild rye, red fescue, camas and clover. The conservation area provides habitat for bald eagles, sea and shore birds. The island is located in the Padilla Bay National Estuarine Research Reserve and provides research and education opportunities.

Local Land Use Designations

Most of the Fidalgo Bay Aquatic Reserve shoreline is located within the Anacortes city limits or the urban growth area of Anacortes. Land use zoning and designations, and potential impacts are covered in Section 3–Ownership and Uses (see Zoning and Land Use Changes). DNR will work with the local governments and Tribes to address those impacts through shoreline master plan development and other mechanisms.

Figure 5: Fidalgo Bay, foraging great blue herons, and Hat Island in background *(Photo: DNR).*

2. Ecosystem Description, Human Impacts and Stressors

This section describes the key elements of ecosystems and habitats of the Fidalgo Bay Aquatic Reserve, and potential impacts and stressors to those systems. This information lays the groundwork to help inform other components of this plan, like the *important conservation elements* (Table 1), and *management objectives* and *strategies* (see Section 5). For a more detailed description of the ecosystem elements and potential stressors described below, see Appendix A.

Ecosystem Description

Geographic Context

Fidalgo Bay is a U-shaped shallow embayment located immediately south and east of downtown Anacortes, Washington in Skagit County (see Figure 3). The bay occupies an ancient delta of the Skagit River consisting of shallow mudflats that drop off steeply into deeper water from Cap Sante Head, adjacent to Anacortes. Gravel and sand spits form prominent features on both sides of the bay. Weaverling Spit protrudes from the western shoreline, while Crandall Spit extends westward into the bay from the March Point peninsula. Small embayments tucks into the southeastern end of Crandall Spit and the shoreline south of Weaverling Spit. Highway 20 flanks the southern portion of the reserve and continues northward parallel to the bay, separating the steeply sloped western uplands from the reserve area. Along the eastern boundary of the reserve two large petroleum refineries occupy most of the upland area of the March Point peninsula.

Physical Description

Fidalgo Bay experiences two low and two high tides of different elevations each day, with an average range between lows and highs of 4.9 ft. (1.5 m.). The bay experiences moderate tidal currents with various wave regimes (National Ocean Survey Tide Tables 1980). Shallow depths and large tidal ranges drive water movement in the adjoining Guemes Channel and entrance to Fidalgo Bay vicinity. The bay is open to southerly and northerly winds but greater wave heights occur when the northerly winds combine with the larger northern fetch distance. Fidalgo Bay is well-mixed vertically with temperatures, salinity and dissolved oxygen measurements similar to regional values (Antrim et al. 2003).

No major freshwater streams flow into the Fidalgo Bay Aquatic Reserve area. However, just south of Anacortes Marina, Ace of Hearts Creek flows down from Heart Lake and maintains minimal year-round flow into the bay. Surface runoff and overland flow, with a few small intermittent creeks, and outfalls are the predominant fresh water sources during the rainy season. Direct seepage around the bay is likely the major freshwater contributor during low precipitation periods (City of Anacortes 2000).

The shoreline around the bay has been modified extensively by fill and armoring. The most notable feature crossing the bay is the late 1800s revetment/causeway and railroad trestle, since converted to a multiple use trail. These features have greatly altered water and sediment movement in the bay by filling small embayments and saltmarsh areas with sediments, eliminating backshore vegetation, and cutting off or drastically reducing the flow of upland sediment to beaches and nearshore areas. These

conditions have resulted in a sediment-starved intertidal zone with significant coarsening of substrate on the upper beach faces (Johannessen 2007).

Extensive intertidal mixed fine/mud flats occupy nearly all the tidal area south of the railroad trestle (Appendix C, Map C–6). The area north of the trestle contains intertidal beaches, lower intertidal and shallow subtidal flats, and deeper subtidal areas, including a maintained channel of about 13.1 feet (4 m.) below mean lower low water (MLLW) (City of Anacortes 2000).

Habitat Characteristics

The aquatic reserve area contains diverse physical habitats that include tidal flats, salt marshes, lagoons, sand and gravel beaches, and expansive native eelgrass beds. These habitat areas provide essential benefits to the reproductive, foraging, and rearing success of many fish, bird, and invertebrate species in the reserve.

Intertidal substrates in the bay include mud, an assortment of mixed fine sediments, organic soils, and mixed sand and gravel (Appendix C, Map C–6). Limited areas of bedrock and artificially hardened shorelines encroach from a narrow backshore zone onto the beaches. In salt marshes, organic soils mixed with sand, silt and clay are the more prevalent substrates. Lower intertidal beaches, tidal flats and the shallow subtidal inner bay are generally composed of mixed fine sediment including clays, silts and fine sands. Deeper subtidal areas include muddy bottoms with varying amounts of sand, gravel or cobble substrate, with a few areas of hard bottom— both natural and human-derived (City of Anacortes 1999).

Eelgrass (*Zostera marina*) covers a significant portion of the lower intertidal and shallow subtidal areas in the reserve. The majority of the eelgrass area in the reserve is north of the trestle and remains stable. In the southern part of the reserve, eelgrass is less robust with more limited depth distribution and diminished coverage. Since 2008, this portion of the reserve has experienced a significant decline. Between 2008 and 2018, the DNR Submerged Vegetation Monitoring Program (SVMP) has documented significant losses in the area south of the revetment, but west of the trestle (Appendix A, Figure A–1).

Figure 6: Native eelgrass and *Ulva* species (*Photo: Aaron Baarna).*

Non-canopy forming kelp mixed with other macroalgae (seaweed) are common in many lower intertidal and shallow subtidal areas in the bay. These may be occasionally intermingled with eelgrass. During the winter months, several species of seaweed, especially red algae, are regularly intermixed with or exist adjacent to eelgrass. Both eelgrass and red macroalgae are the most common substrate for herring spawn deposition in Fidalgo Bay. Macroalgae is also considered a key habitat component of the bay (Pentec 1994; D.

Penttila, Salish Sea Biological, personal communication, 2019) and, like eelgrass, provides critical habitat for many invertebrates and fishes.

Saltmarsh vegetation, dominated by pickleweed and saltgrass, can be found intermittently fringing the shoreline including the spits. Along with the fringing marsh plants in the southern end of the bay, bulrushes expand into the mudflats, often topping isolated eroding mounds that are patchy distinctive features at slightly lower tidal elevations.

Areas of beach spit and berm vegetation habitat are present along the upper beach face of Crandall and Weaverling Spits, and in narrow margins or constrained backshore zones around southern portions of the bay. Subjected to salt spray and infrequent inundation, this unique splash zone habitat promotes a different plant community, including: dune grass, gumweed, yarrow, and silver burweed.

Fish and Wildlife Resources

Despite changes to the adjacent uplands, much of the aquatic land within the reserve supports high quality habitat for numerous fishes, migratory and resident birds, and marine invertebrates. Extensive aquatic vegetation, diverse substrates and sufficient ecosystem functions within the upland-marine interface provide for these productive habitat areas.

In neighboring Padilla Bay to the east and nearby waters, at least 57 species of fish have been identified (UDC 1980). Many of these species are likely to use nearby Fidalgo Bay, with its similar habitat. Appendix B, Table 2 provides a current list of fish species observed in Fidalgo Bay.

Fidalgo Bay's large tidal flats and pocket estuary habitat contain productive eelgrass and macroalgae beds (Appendix C, Map C–8). These in turn provide important structure and prey resources for juvenile salmonids, for example: harpacticoids, copepods, and amphipods. Juvenile chum, pink and Chinook salmon are known to occur in Fidalgo Bay during spring out-migrations (T. Woodard, Samish Indian Nation, personal communication, 2019). These are likely Skagit and Samish River-derived stocks (Beamer et al. 2006). Puget Sound Chinook salmon meet the listing criteria for State Candidate and Federally Threatened species. Puget Sound/Strait of Georgia coho salmon is listed as a Federal Species of Concern. While no published information exists on the occurrence of bull trout in Fidalgo Bay, the area is located in the proposed critical habitat for coastal bull trout (Federal Register 2005b).

Forage fish are small, prolific species of fish that constitute a major portion of the diets of salmonids and other fishes, seabirds, and marine mammals. Three species of forage fish—Pacific herring (Figure 7), surf smelt and Pacific sand lance —use intertidal beaches and shallow subtidal areas in Fidalgo Bay for spawning habitat. Extensive surveying for forage fish spawning beaches in the reserve area has found that surf smelt spawning occurs year round. In particular, surf smelt spawn prolifically and almost everywhere on beaches north of the trestle. Adult herring are reported to congregate outside the bay in the area to the east of Guemes and Hat Islands (WDFW 2019), before periodic migrations into Fidalgo Bay for spawning (Appendix C,

Figure 7: Pacific herring *(Photo: Oregon Coast Aquarium).*

Map C–11). Herring larvae are present in the south bay after hatching, and after the first summer they likely vacate the immediate area to grow and mature (D. Penttila 1991). Throughout the 1990's and earlier, herring spawn had been found wherever eelgrass existed in the bay, even in areas where eelgrass is distributed only sparsely (Penttila 1995). Once considered a medium-sized northern herring stock in Washington State, the Fidalgo Bay stock has decreased substantially since 2001. The stock is now listed in State Critical status (WDFW 2018). Because of uncertainty regarding factors limiting the Fidalgo Bay herring population, WDFW considers the status of this stock of particular interest (WDFW 2018). More details can be found in Appendix A.

Marine flatfish such as starry flounder, rock sole, English sole, and sand sole typically use the mudflats and shallow embayments found in Fidalgo Bay. Most of these species may remain in nearshore waters even as adults (L. LaClair, WDFW, personal communication, 2019).

Figure 8: Common loon *(Photo: Ron Holmes*).

Fidalgo Bay provides foraging and resting grounds for many resident and migratory shorebirds, seabirds and waterfowl (collectively "waterbirds"). About 239 bird species are known to use Fidalgo, Padilla and Samish bays. Several birds of interest include brant, cormorants, peregrine falcons, loons, bald eagles, as well as many shorebirds, dabbling and diving ducks (see list of observed species, Appendix B, Table B–1). The diverse and abundant bird use in the bay is in part due to the bay's location within the Pacific flyway.

Of particular note in this area is the large great blue heron rookery located on the southeast side of March Point. Birds from this rookery regularly feed in Fidalgo Bay (Antrim et al. 2003; Eissinger 2007). WDFW lists protections of nesting colonies of great blue herons as priority habitat. The heron rookery at March Point hosts one of the largest concentrations of great blue herons on the west coast and is called out to by Skagit County as an official Habitat and Species of Importance in the Skagit County Critical Areas Ordinance (Skagit County Code 14.24.500(4)). The Skagit Land Trust has proposed (July 27, 2018) an update to the ordinance to include greater protections for this important habitat.

Bird species protected under the Federal Endangered Species Act occurring in or near Fidalgo Bay include: marbled murrelet (Threatened), peregrine falcon and bald eagle (Species of Concern). Several bird species known to use this area meet the listing criteria for Washington State Endangered, Candidate, or Sensitive Species, including: the Western grebe, common loon, Vaux's swift and marbled murrelet. In recent years, the American white pelican (State listed as Threatened)

has had a regular summer presence in nearby Padilla Bay and nesting has been documented. Fidalgo Bay includes habitat that may attract white pelicans in the future. (T. Manns, Skagit Audubon, personal communication, 2019).

Invertebrates, such as marine worms, snails, clams, crabs, shrimp and other crustaceans provide vital links in the Fidalgo Bay food chain. Many of these invertebrates are primary consumers and support local populations of birds, fishes and mammals. For a list of other marine invertebrates found in the bay, see Appendix B, Table 3.

Harbor seals regularly forage in the bay. While no harbor seal haul-out sites are located within the reserve, several are located nearby (Jefferies 2000). River otters, raccoons, mink and Columbia black tailed deer are known to forage along the shoreline and within the southern portion of the bay (T. Woodard, Samish Indian Nation, personal communication 2019).

Human Impacts and Ecosystem Stressors

Various forces, both natural and human-caused, may impact the creatures, habitats and ecosystems of Fidalgo Bay. These can be grouped into two categories: Large-scale or societal forces driving observed and future changes and the actual physical or biological stressors affecting organisms and systems. When combined, these can profoundly impact ecosystem health.

Potential Drivers of Future Change

Multiple human-derived pressures may contribute to (or "drive") future changes that could affect the reserve's species, habitats and ecosystems. In particular, human *population increase* and *climate change* are expected to drive future changes substantially. Understanding these drivers can help managers anticipate and plan more carefully, preparing for possible contingencies. Each potential driver is described below.

Regional and Local Population Increase

Population growth both regionally and locally will continue to influence the degree of use and environmental quality within the reserve. According to Washington's Office of Financial Management (OFM), Washington has been gaining about 1,000,000 people per decade, and Skagit County is projected to gain nearly 17,000 people between 2020 and 2030 under a moderate growth scenario. There were about 16,600 people living in the City of Anacortes in 2010 (OFM 2018).

This rapid growth is the main focus of anticipated future impacts to the aquatic reserve. Expanding growth will contribute to a suite of potential impacts through ground water withdrawals, increased impervious surface area and associated runoff, increased sewage, and greater overall impacts to local infrastructure, including recreational areas. These changes could also affect habitat of upland species that utilize the reserve.

Many existing programs, zoning laws, and shoreline designations will help mitigate potential impacts of population growth. For instance, shoreline land uses are controlled by the City of Anacortes and Skagit County's Shoreline Master Programs (SMP). The city's SMP Environment Designation of "Conservancy" adjacent to the reserve, as well as existing land elevation and slope constraints limit further upland buildout in areas surrounding the southern portion of the bay. Additionally, annual updates to the city's Stormwater Management Plan provide a check and review to help accommodate and mitigate for proposed expansion and land use changes. For example, the WSDOT's recently

constructed stormwater bio-swales on Highway 20 at the Sharpe's Corner round-about provide mitigating filtration for stormwater, which would otherwise enter the bay untreated.

Climate Change

Physical, biological and chemical changes to the marine environment associated with climate change will intensify naturally occurring events and conditions and in Fidalgo Bay. Current trends in climate change may contribute to the following ongoing fluctuations in ocean conditions (Snover 2013), all of which could have an impact on existing physical and biological resilience in the aquatic reserve area:

- Sea level rise and storm surge will inundate low-lying areas adjacent to the reserve.
- Sea level rise will further submerge current subtidal and intertidal habitat areas, having the potential to adversely affect fish and wildlife resources and associated habitat.
- Rising water temperatures will create additional stressors on marine organisms.
- Lower dissolved oxygen concentrations, related to increases in water temperature, will create additional stressors for fish and at extreme levels can be fatal.
- More frequent and heavy precipitation events can contribute more pollutants and alter water chemistry.
- Increased nutrient loading can cause eutrophication[3], which intensifies the effects of decreased pH and low dissolved oxygen.
- Ocean acidification can make it difficult for calcifying organisms, such as Olympia oysters and other shellfish to produce shells. It can also affect biological processes such as bio-sensory functions in salmon and forage fish, inhibiting their ability to locate natal areas, food sources, and to detect predators.

Figure 9: February, 2015 damage to the causeway revetment from storm surge *(Photo: DNR).*

Sea-level rise due to human-caused climate change is predicted to increase in the Puget Sound Region. In the Fidalgo Bay area, based on the "most likely to occur" scenario over a 10-year period from 2020–2030, sea level is projected to rise from 2.4–5.9 inches (Miller et al. 2018). A more

[3] Eutrophication: Excessive richness of nutrients in a water body, frequently due to runoff from land, which causes a dense growth of plant life and death of animal life from a lack of oxygen.

detailed summary table is included in Appendix A, Table 1 and includes two additional time periods, two greenhouse gas emission scenarios, and a range of probabilities for more extreme estimates.

Compounding the effects of sea-level rise, increasing storm intensity and frequency will also produce greater wave energy, more wave runup[4], and more extreme storm surges (Grossman et al. 2018). These combined effects will cause erosion and alterations to the shoreline and the physical structure in the bay.

Since Fidalgo Bay is a relatively narrow, confined "U-shaped" bay, it is more vulnerable to the impacts of increased storm intensity and frequency (Figure 9). This could result in altered substrate composition, increased scour and changes to nearshore bathymetry. Additional consequences could reduce light availability, bury submerged aquatic *vegetation*, and potentially damage or destroy adjacent infrastructure and upland vegetation.

The extensive armoring and physical location of infrastructure in and adjacent to Fidalgo Bay may intensify effects and limit opportunities to buffer the impacts described above. Such armoring includes transportation infrastructure surrounding the reserve on three sides (State Highway 20, March's Point Road, and Fidalgo Bay Road), development along the City of Anacortes shoreline, the southern portion of the Fidalgo Bay Resort on Weaverling Spit, and two refineries on March Point.

The Samish Indian Nation is currently working with USGS to develop a more detailed sea level rise model, bringing in wave and storm surge data for the area (including Fidalgo Bay) to better inform the community about potential impacts (T. Woodard, Samish Indian Nation, personal communication, 2019). DNR's Acidification Nearshore Monitoring Network (ANeMoNe) was established in 2016 to measure and understand trends in pH and acidification occurring in shallow marine waters across Washington State related to climate change. The ANeMoNe instruments at Weaverling Spit in Fidalgo Bay collect continuous (sub-hourly) water quality data like temperature, dissolved oxygen, pH, and salinity. These efforts will contribute to a greater understanding of potential climate impacts in the bay.

Spills of Toxic Substances

Spills of toxic substances could affect the ecosystems, natural resources and human values associated with the reserve. This is especially true given the proximity of the reserve to a major state highway, an active railroad, two large petroleum refineries, bulk fuel loading docks in the bay, a petroleum pipeline, marinas and various maritime shipbuilding industries. In 1991 over 23,500 gallons (560 barrels) of crude oil were spilled into the bay from the Texaco refinery, entering the east shore of the bay through an industrial stormwater pipe not far from the trestle. Oil fowled many birds, beaches, salt marsh and intertidal habitat areas along the southeast shore. A cleanup and subsequent settlement for natural damages funded the purchase of tideland properties, beach enhancement and restoration actions along the eastern shoreline. Depending on the size and magnitude of a spill, considerable resources may be required and ecosystem recovery can take months, years or decades.

[4] Wave runup: The additional height that a broken wave attains as they run up the shore before their wave energy is dissipated due to friction and gravity.

Land Use Changes

Changes in adjacent ownership or future land uses could also affect the bay. For example, if substantial changes were made to industrial, residential, or open space designations near the reserve, it could affect the levels of risk associated with water quality degradation or potential toxic spills. If residential ownership were to increase near the bay it could also spark more interest in how the reserve is managed, or create additional demand for public access to the reserve. However, any such changes will be guided by requirements of Washington's Growth Management and Shoreline Management Acts, involving ample public input (see Section 3–Ownership and Uses, Zoning and Land Use Designations). Additionally, the scale of current transportation infrastructure immediately adjacent to the bay would likely limit future changes to shoreline uses.

Increased Recreational Use

Anacortes and nearby waters will continue to see increased recreational boat traffic—supported by a continued demand for boating, favorable docking and mooring sites, and close proximity to the San Juan Islands and other desirable destinations. Additional boating use in the bay may increase the likelihood of impacts such as chronic lubricant and fuel leakage, marine debris, increased boat wake activity, propeller scour, physical disturbance to wildlife, impacts from pet and human waste, and increased shading of aquatic vegetation from boat moorages and overwater structures.

Greater recreational use of public access sites, including the Tommy Thompson Trail and the Fidalgo Bay Resort, could adversely impact habitat and wildlife resources through increased physical disturbance. Additional pressure to biological resources from fishing, crabbing, clamming may exacerbate existing issues of poaching and perceived overharvest.

Ongoing educational programs and existing signage that fosters public awareness and stewardship of natural resources and the ecological values of Fidalgo Bay will help build support for policies and actions protecting the bay, and will help mitigate potential effects of overuse.

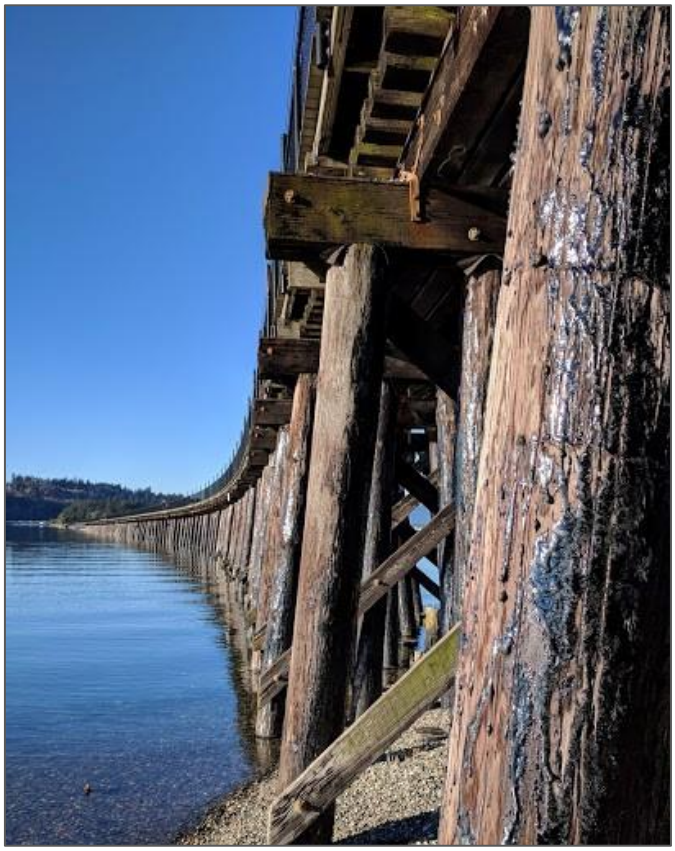

Figure 10: Creosote pilings support the Tommy Thompson recreational trail across the bay. *(DNR Photo)*

Environmental Restoration

Removing creosote pilings—especially the hundreds of supports for the Tommy Thompson Trestle (Figure 10)—would eliminate a source of contaminants and improve long-term sediment and water quality. Replacing the trestle and associated causeway (Figure 9) with a more flow-friendly design could restore more natural current, wave, and sediment movements that have been altered for more than 130 years. Restoring beaches, salt marsh habitat and adjacent riparian areas could provide greater spawning opportunity for forage fish, and improved foraging activity for juvenile salmonids and other wildlife in the

bay area. The Fidalgo Bay Causeway Feasibility Study Report (Ridolfi 2008) was prepared for the Samish Indian Nation to provide preliminary information and options for removing the causeway and trestle. Additionally, the Samish Indian Nation has conducted a Fidalgo Bay Salt Marsh Restoration Feasibility Study (Ridolfi 2014) examining options for restoring beach and salt marsh habitat on private tidelands just south of the Fidalgo Bay Resort.

Land Conservation and Protection

Additional aquatic land parcels could be added to the reserve in the future, expanding the management boundary. This could include either private tidelands donated to DNR, or state owned bedlands to the north of the reserve. Also, protection or restoration of upland parcels could influence freshwater inputs (i.e. enhanced water quality) to the bay. Tree planting and restoration of shoreline riparian areas could provide shading and nutrients to improve poorly functioning nearshore areas. Recently the Skagit Land Trust purchased a one-quarter acre residential property with 200 feet of shoreline on the southwest shore of the bay. The upland structures have been removed and restoration of riparian vegetation is ongoing.

Ecosystem Stressors

The larger scale drivers affecting change discussed above contribute to the level of stress experienced by the organisms, habitats and ecosystems of the bay. A number of ecosystem stressors and potential future impacts have been identified in Fidalgo Bay, which may affect the health of the reserve. The term *ecosystem stressor* refers to any condition or agent causing a potential stress response or impact to the ecosystem, whether physical or biological. Knowledge of the stressors affecting reserve ecosystems can help managers anticipate, alleviate and avoid further impacts through management actions. Additional details on each stressor can be found in Appendix A.

Effects of Shoreline Modifications on Habitat

Shoreline modifications, including filling of historic backshore, saltmarsh and upper intertidal areas, shoreline armoring, overwater structures, and loss of shoreline riparian vegetation, are the primary contributors to altered physical processes and the reduction of important habitat areas in the bay. Historically, Fidalgo Bay was connected via a shallow tidal slough to Similk Bay, approximately two miles to the south. In the late 1800s the slough was cut off and the area between the two bays was diked and drained to create farmland. This action permanently eliminated estuarine habitat, cutting off the natural flow of water and sediments to the head of the bay. This change, along with construction of the railroad trestle and causeway has contributed to decades of greater siltation in the south end of Fidalgo Bay. Around 1930 the construction of a golf course further filled, drained and altered original wetland habitat in the area.

A detailed analysis of armoring in the bay by Antrim et al. in 2003, showed dramatic continual erosion to Crandall Spit, substrate coarsening on beach faces, loss of substrate elevation along armored shoreline, as well as a two to four feet of sediments deposited and gained in areas south of the trestle (Antrim et al. 2003; Williams et al. 2003). The rate of erosion at Crandall Spit over the last 16 years has not been quantified.

Intertidal and shallow subtidal habitats available for native hard-shell clams have been reduced or eliminated in some areas by shoreline fill or alterations to the substrate. Fill and armoring have also buried or “squeezed” upper intertidal areas on beaches throughout the bay, restricting habitat availability for beach spawning forage fish and foraging birds. The compounded loss of shoreline vegetation reduces food resources and availability for juvenile salmonids, and can lead to increased forage fish egg mortality from drying and sun exposure.

Habitat impacts from armoring are beginning to be addressed through beach enhancement and other restoration techniques, with ongoing or completed projects described in Section 4 and Appendix A.

Effects of Overwater and In-Water Structures on Habitat

Historic losses of eelgrass, including herring spawning habitat and upper intertidal beach spawning habitat have occurred in Fidalgo Bay. Some of this loss is a direct impact from dredging in the bay and the filling adjacent shoreline areas (Williams et al. 2003). Smaller areas of eelgrass and macroalgae have been eliminated by shading from overwater structures such as the March Point piers and the railroad trestle/revetment (Penttila 1995). Additionally, the barriers to circulation created by the trestle and later, the extensive riprap revetment, have substantially decreased water and sediment flow rates for more than 100 years in the south portion of the bay. These changes have led to increased turbidity (reduced water clarity) and deposition of fine sediments over time. Major losses of eelgrass directly south of the revetment have recently occurred between 2009–2018 (DNR Nearshore Habitat Program 2019), potentially related to sediment deposition.

Sediment and Water Quality Impacts

Although the overall quality of the bay benefits from a twice-daily tidal flushing, Fidalgo Bay is a very shallow embayment that has experienced multiple historical uses adversely affecting water and sediment quality. Regardless of major improvements in environmental practices and policies, the bay remains vulnerable to degrading impacts from a range of sources. Although water and sediment sampling have occurred only irregularly in or near the reserve, samples have generally shown water and sediment quality to be relatively clean or within normal background levels, with occasional exceptions.

Roadways and impervious surfaces can contribute to water quality impairments and affect the quantity of freshwater flows. As future development occurs, the compounding effects of more impervious surfaces will reduce the amount of upland recharge area, reducing the capacity to store water for later release through groundwater recharge. This could negatively affect the amount of freshwater inputs into the bay during dry periods if not mitigated effectively. Increased traffic and development also produces greater amounts of contaminants that can later enter the bay through runoff, drainage ditches, or outfalls. During early fall rains, soil and other built-up contaminants are released from roads and other impervious surfaces as overland flow. In more heavily populated areas, such intense contaminant-laden runoffs have been known to result in localized fish kills in the freshwater environment. The recent traffic circles and widening to Highway 20 could potentially increase the amount and focus of direct discharge or seepage into the bay. As part of this project, the Washington State Department of Transportation installed several new bio-swales to treat highway runoff and reduce potential contaminants associated with runoff from Highway 20 entering the bay.

Recently, through participation in the WDFWs Mussel Watch Program, data on mussel ingestion of waterborne contaminants in the reserve showed comparatively low concentrations of contaminants like PAHs (polyaromatic hydrocarbons), metals, and others. During three winters of sampling from 2013–2018, approximately 150 separate chemicals were analyzed from two sites at Weaverling Spit and the northern end of March Point. The Weaverling Spit site tested “pretty clean” for all contaminants (J. Lanksbury, WDFW, personal communication, 2019), and both sites have tested consistently low for PAH’s. The observed PAH chemical types that were observed were mostly attributed to airborne combustion sources, not from recent spills. This finding is of interest due to the presence of nearby refineries and previous oil spills occurring in the bay.

Excess nutrients and biological pathogens could enter the bay through poor agricultural practices, such as unmanaged livestock waste, combined sewer outfalls, septic system failures, or from direct discharge of untreated sewage. The Skagit Conservation District has worked with upland farm managers adjacent to the reserve to implement Best Management Practices to improve and protect water quality and reduce the potential for runoff of agricultural nutrients (B. Blake, Skagit Conservation District, personal communication, 2019).

Figure 11: Anacortes Veneer, which later became Custom Plywood operated on this site from 1939-1992, when it burned down. Photo from the early 1950s. *(Photo courtesy of Anacortes Museum).*

Slightly northwest of the aquatic reserve, historical industrialization of the shoreline has contributed to the degradation of local sediment and water quality through deposition of wood waste and industrial debris. From 2007–2013 the Washington Department of Ecology's Toxic Cleanup Program undertook a major cleanup of sites in Fidalgo Bay. The site closest to the reserve is known as the Custom Plywood Mill site (Figure 11). For over 100 years, this site hosted wood mill operations producing at various times lumber, boxes, wooden pipes, shingles and plywood until it burned down in 1992. The dilapidated mill structure partially constructed of creosote pilings built out over the bay, coupled with the massive amounts of unconfined sawdust, burned wood and other wood waste, was considered the largest contributor to contaminants found in the bay. Large portions of nearshore areas in close proximity to the northwestern reserve boundary were affected by toxic contaminants, particularly dioxins. In the last 10 years, most of the wood waste and contaminants have been cleaned up, with the remaining contaminated substrate to be permanently capped or mitigated by 2020.

Although more than a thousand creosote pilings were removed as part of the Custom Plywood Mill cleanup, removing a major source of PAH contaminants, more than 750 creosote pilings still make up the substructure of the Tommy Thompson Trail trestle across the bay (Figure 10). Creosote leaches into the water and the surrounding substrate, and higher levels of PAHs have been found in the sediment around the pilings (Ridolfi 2008).

However, the overall sediment quality in the reserve area appears to be relatively clean, varying with the diversity in sediment grain size and tidal elevation. Prior studies in the area have determined that, with the exception of the PAH constituents discussed above, the levels of metals and organic

compounds in reserve area sediments are comparable to (or lower than) other uncontaminated areas in Puget Sound.

Oil Spills

The effects of oil spills on organisms, ecosystems and wildlife are well-known and vary depending upon the type of oil, weather, tides and other conditions. Effects could vary from minor to acute. In 1991 over 23,500 gallons (560 barrels) of crude oil was spilled into the bay from the Texaco refinery, entering the bay through an industrial stormwater pipe on the east side of the bay not far from the trestle. Oil fowled many birds, beaches, salt marsh and intertidal habitat areas along the southeast shore.

Currently, two oil refineries operate on March Point adjacent to the eastern boundary of the reserve. The southern refinery is owned by Shell Oil, and the northern by Marathon Petroleum. Multiple pipelines transporting crude and processed oil to and from oil tankers run adjacent to the reserve along the eastern boundary. At little Crandall Spit (just south of Crandall Spit), the pipelines extend out over the bay for 1.5 miles to the refinery's loading docks. The refineries have many procedures and technologies in place to significantly reduce the likelihood of oil spills or minimize spill volume. However, spills have occurred in the past and the possibility exists for future spills.

Other possible sources of petroleum-derived pollutants and contaminants are prevalent adjacent to the reserve area. These include road runoff, exhaust or spills from vehicles on Highway 20 or March's Point Road, residential areas, and various commercial facilities northwest of the reserve.

The Department of Ecology is responsible for creating and maintaining Geographic Response Plans (GRP) outlining initial spill response at marine and inland waters in Washington. Each GRP specifies actions and prioritizes locations to protect first. Currently, the North Puget Sound GRP from 2011 covering Fidalgo Bay is in the process of being updated. The 2011 GRP established booming strategies to protect sensitive areas and resources of the bay, including Crandall and Weaverling Spits.

Ecology's Oil Spill Response Team, in collaboration with Samish Indian Nation supported the purchase of a boat to aid in oil spill response. The vessel is scheduled to be delivered in May 2019, enabling trained tribal staff to transport spill response staff, equipment and Natural Resource Damage Assessment personnel in traditional Samish territory.

Non-native Fauna and Flora

Non-native species can disturb native ecosystems by physically displacing, outcompeting, or consuming native species, and upsetting the balance of the natural ecosystem. In other cases, a species may not have an immediate, obvious, or significant long-term impact on the native biological community or habitat. A wide variety of non-native invertebrates persist in the area.

In the summer of 2016, a few invasive European Green crabs (*Carcinus maenas*) were found in neighboring Padilla Bay. Seasonally, from spring through September in both 2017 and 2018, the Samish DNR and Washington Sea Grant (WSG) Crab Team have performed monthly monitoring for European green crab. Thus far they have not found any molts or green crabs during their surveys. However, in August 2018, a green crab carapace was found on the beach at little Crandall Spit in the aquatic reserve. As a result, WDFW's Nuisance Species Program set out an aggressive trapping array in accessible and likely habitat areas in the most southern portion of the bay, but did not trap any green crab. The Samish DNR and the WSG Crab Team intend to continue their seasonal monitoring

program, and WDFW will regularly monitor areas in the south bay to prevent green crab establishment (A. Pleus, WDFW, personal communication, 2019).

Other non-native invertebrates include the purple varnish clams and the abundant Asian mud snail (Antrim et al. 2003). Although the Japanese littleneck clam and Pacific oysters are present in the bay and are of foreign/non-native origin, they are not considered nuisance species. Bryozoans and invasive tunicates are the other documented non-native organisms of concern in the bay (Cohen et al. 1998). However, neither organism has been identified at any Olympia oyster restoration or spat colonization sites over many years of sampling.

Common cordgrass (*Spartina anglica)* was detected and removed in Fidalgo Bay for the first time in 1999. Since then, the Skagit County Noxious weed crew regularly monitor these areas and have removed small isolated infestations. Two sites in the reserve area, at Sharps Corner in the south end of the bay and in the Samish RV Park's inner bay, continue to have re-infestations of *Spartina.* The non-native seaweed, *Sargassum muticum*, and Japanese eelgrass (*Zostera japonica)* are also present in Fidalgo Bay, but not extensively in the reserve area.

Increased Recreational Use and Habitat Disturbance

Physical disturbance as well as the active capture and harvest of organisms can negatively affect the ecosystems of the reserve. As human populations in Skagit County and around Anacortes increase, the demand for recreation in or adjacent to the reserve will continue. Extractive recreation like fishing, crabbing, clamming and waterfowl hunting can affect populations of organisms in the bay – either through the removal of individuals, or the physical stress of harvest on adjacent (non-harvested) individuals. For example, during smelt season, intertidal organisms may get trampled while fishers are dip netting for surf smelt. Increased boating activity in the bay could increase the total stress on foraging and resting waterbirds, as well as harbor seals. Increased use of tidelands and the Tommy Thompson Trail could increase the degree of physical disturbance to wildlife utilizing the bay.

3. Ownership and Uses

This section examines the human uses in and around the reserve, both historic and current. It includes a brief discussion of ownership, as well as current zoning affecting the type of uses nearby. Factors driving potential future uses were described in Section 2 (see Potential Drivers of Future Changes).

Aquatic Ownership in and Adjacent to the Reserve

All of the tidelands and bedlands within the reserve boundary are state-owned, and are managed by DNR (Appendix C, Map C–1). Private tidelands adjacent to the reserve were generally platted to extreme low tide. A legal description of the reserve boundary is included in the DNR Withdrawal Order in Appendix E.

Ownership types adjacent to the reserve include tribally-owned uplands and tidelands, private residential uplands and tidelands, commercial uplands, agricultural uplands, industrial refinery-owned uplands and tidelands, one parcel of uplands and tidelands held in private conservation, county road and state highway ownership. Two dominant natural features of the bay, both adjacent to the reserve, are Weaverling Spit on the western shore (owned by the Samish Indian Nation), and Crandall Spit to the northwest (owned by Shell).

Prior to creation of the Fidalgo Bay Aquatic Reserve, most of the tidelands currently in the reserve were privately owned. In 1999, the Skagit Land Trust acquired and conveyed ownership of 450 acres of tidelands in the southern portion Fidalgo Bay to the State, under a permanent conservation easement (Appendix C, Map C–2). In 2006, the land trust added another 82 acres through an amended easement. Lands from these gifts currently make up approximately two-thirds of the reserve area.

Aquatic lands beneath the Tommy Thompson Trail were originally owned by the Seattle and Northern railroad prior to statehood, and thus were never owned by the State. The City of Anacortes subsequently acquired this land from the railroad and received federal funding to convert the railroad to a trail.

Harbor Areas and waterways, as designated in State statute (see RCW 79.120.010, RCW 79.115.010) still exist within the reserve. However, aquatic lands within the reserve, including the Harbor Area and waterways, were withdrawn from DNR's general leasing program under the 2008 Commissioner's Withdrawal Order that created the reserve (Appendix E). Under the Withdrawal Order, the Harbor Area is no longer reserved for landings, wharves, streets, and other conveniences of navigation and commerce under RCW 79.115.010 and WAC 332-30-109. Similarly, any uses allowed in the waterways must clearly be consistent with the reserve's purpose and management goals and fall within the Allowable Uses outlined in Chapter 6. Waterway uses will not be prioritized or authorized under WAC 332-30-117(4).

Cultural and Historic Uses

The protected shores and productive tidelands and waters of Fidalgo Bay have been used for at least the last 10,000 years by Coast Salish (Lkungen-speaking, Lushootseed-speaking, and Xws7ámeshqen-speaking (Samish)) tribes, as winter gathering and village sites (Ruby and Brown 1992). This is evidenced through tribal stories and multiple locations of shell midden deposits, Neolithic scatter, and sacred burial sites near the reserve (Washington DAHP database 2018).

Figure 12: Two Native Americans, probably from the Samish tribal village on Guemes Island, in a dugout freight canoe. The man in front is holding a salmon harpoon *(Photo courtesy of Anacortes Museum).*

Although there are no recorded archaeological sites reflecting pre-historic uses of the reserve's tidelands and bedlands *per se*, such sites may still exist. This is due to the shallow depth and geologic history of the bay and immediate surroundings, as well as the potential for archaeological resources to have been deposited (either accidentally or purposefully as in-water features) at known documented sites in similar embayments in Western Washington (M. Major, Washington DNR, personal communication, 2018).

Historically, Fidalgo Bay was connected to the north end of Similk Bay through a slough, passable at high tide, which would have supported shallow vessel traffic (B. Carteret, Friends of Skagit Beaches, personal communication, 2019; See Figure 13). In the late 1800s, the area between the two bays was diked and drained for farmland cutting off this connection

Figure 13: View looking northwest from the southeast corner of Fidalgo Bay around 1890. Prior to shoreline diking, a slough was known to connect Fidalgo to Similk Bay *(Photo courtesy of Anacortes Museum, Wallie Funk Collection).*

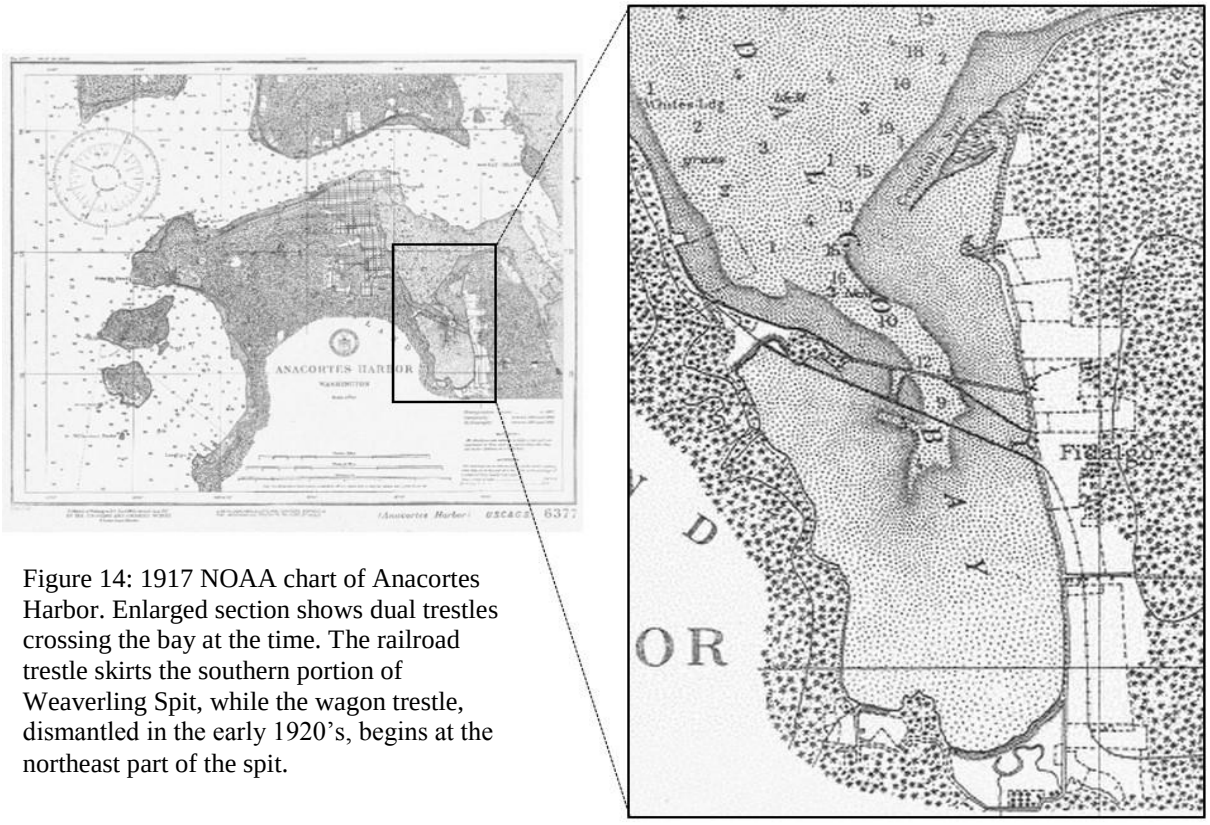

Figure 14: 1917 NOAA chart of Anacortes Harbor. Enlarged section shows dual trestles crossing the bay at the time. The railroad trestle skirts the southern portion of Weaverling Spit, while the wagon trestle, dismantled in the early 1920's, begins at the northeast part of the spit.

Homesteading settlers first moved into the area in 1850s following the Treaty of Point Elliott, which ceded tribal lands to the United States but reserved some rights to fishing and shellfish harvest. Settlement around Fidalgo Bay expanded for several decades, especially along the eastern and southern shore of the bay.

In 1872, the first General Land Office map of the area showed three settlers. By 1909, the USGS map showed nearly two dozen structures scattered around the bay, linked by an unpaved shoreline road. By the 1936 map, however, the number of structures on the east side of Fidalgo Bay was decreasing, while nearly every flat area on the steeper west shore was occupied.

During this time, the growing City of Anacortes provided a valuable deep-water port from which to ship goods like timber products and seafood. In 1890, the Seattle and Northern Skagit railroad line was completed from Sedro-Woolley to Anacortes, creating a boom of settlers and businessmen to the City of Anacortes and surrounding area. Two trestles were built across Fidalgo Bay in 1890, one for rail traffic and the other for horse-drawn wagons (Figures 14, 15).

Figure 15: Photo from 1907 of railroad trestle looking east from Weaverling Spit. Note wooden piling construction of entire trestle prior to causeway construction *(Photo courtesy of Anacortes Museum).*

The wagon trestle was abandoned in the early 1920s and subsequently removed. In the early 1920s (see article in Anacortes American 8-12-1920 stating blasted rock at Spit would be used to construct causeway), a rock and earthen causeway was constructed across the western half of the trestle, replacing the wooden pilings[5]. The train trestle (Figures 10, 14, 15) has been in place for nearly 130 years and is recorded in the State's DAHP database as a historical archaeological site.

The railroad enabled the shipment of logs and lumber to and from local mills. Many mills sprang up along the western shorelines of Fidalgo Bay near Anacortes, operating for decades. For example, Hodges (2003) notes that by 1907 there were 68 wood products mills shipping products through Anacortes. These included lumber, pulp, plywood, shingle, and box mills. By 1922 Anacortes was considered the largest log trans-shipment point in the United States, and by 1928 there were four sawmills, three box factories, five shingle mills, and a pulp mill operating within the Anacortes city limits (Slotemaker 2002). In order to supply the mills, tugboats regularly floated rafts of logs by the hundreds into Fidalgo Bay, north of the trestle. Logs were also dumped into the western portion of the bay from rail cars. For example, Mitchell's Log Booming (Figure 16) operated just North of

[5] Aug. 12, 1920 article in the *Anacortes American* reported contractors were to explode 75 tons of high explosives on the point… and "lift the whole point off and break it up to a great extent. Rock will be used for riprapping fill being put in across Fidalgo Bay"

Weaverling Spit for more than half a century, using 30–35 rail car loads of logs per day to supply Anacortes mills (Friends of Skagit Beaches, Trail Tales signage).

Thus, many portions of the bay – especially north and west of the trestle – were used for decades to boom rafts of floating logs (Figures 16, 17), many of which would rest on the exposed tidelands during low tides. This practice continued in the bay up through the 1970's, with the last mill (Custom Plywood) closing in 1992 following a catastrophic fire.

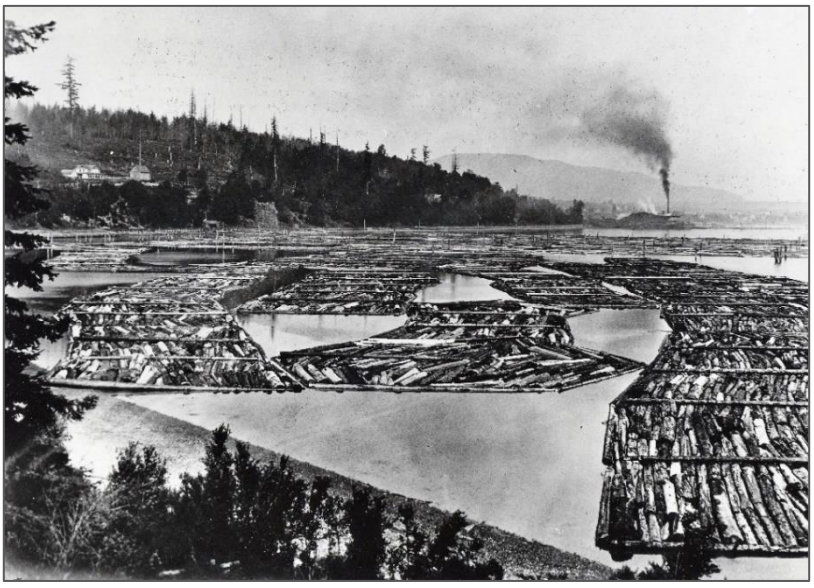

Figure 16: Early photo looking north toward Anacortes from Weaverling Spit. Mitchell's Log Booming occupied tidelands north of the spit for decades, feeding many early mills *(Photo courtesy of Anacortes Museum).*

In contrast to that portion of the bay north of the trestle, the relatively protected southern portion has experienced very few uses due to its presence as a barrier for nearly 130 years. No log storage or mill activity was ever known to occur there.

Transportation, Industrial and Refinery Activities

In the mid-late 1950s the fields and forestlands on March Point (to the east and north of the reserve) were replaced by two large petroleum refineries. This required extensive earth moving and construction activity, including the filling of tidelands and construction of March's Point Road, which today forms nearly all of the reserve's eastern boundary. The northern refinery is now owned by Marathon Petroleum and the southern is owned by Shell Oil. Together the two refineries have employed hundreds of workers for many decades, with a current combined production of a quarter million gallons of petroleum product per day (Shell 2018, Marathon 2018). Raw materials and refinery products are shipped by rail, truck, tanker ship, barge, and underground pipelines.

Although the refineries have had relatively few environmental spills causing impacts to the bay over 60 years of operations, in 1991–1992, four separate but related oil spill events spilled more than 23,500 gallons (560 barrels) of crude oil into the bay from the Texaco refinery (now owned by Shell). Oil entered the east shore of the bay through an industrial stormwater pipe not far from the trestle (WDFW 2004). Beaches, intertidal areas, wildlife, and cultural resources in the bay were affected by oil. A subsequent Natural Resources Damages Assessment in 2004 awarded money for beach restoration work, which occurred along the reserve's eastern boundary in 2008–2009 (see Appendix A —"Restoration, Enhancement and Mitigation of Impacts"). The refineries have instituted multiple measures, plans and contingencies in place to prevent future spills. They have also contributed significant staff time and money to environmental monitoring and restoration activities in the bay over the years.

Figure 17: Log rafts and refinery activity north of the trestle in Fidalgo Bay around 1960
(Photo courtesy of Anacortes Museum).

State Highway 20 is a major highway, transporting approximately 34,000 vehicles per day to Fidalgo and Whidbey Islands (DOT 2017). This highway, with an estimated 2,500 feet of right-of-way abutting the southern reserve boundary, poses a potential source of spills and stormwater runoff into the bay. From the 1950s through the 1980s, many of the City of Anacortes' wood products-related waterfront properties were converted to commercial marinas, vessel maintenance and upland storage facilities. While not located within the reserve itself, these commercial activities pose potential environmental threats to water and sediment, possibly affecting the reserve. However, extensive cleanup and mitigation of contaminated sediments has also occurred at many of these sites, improving environmental conditions near the reserve. In 1992, the Custom Plywood mill (Figure 11), located approximately one mile north of Weaverling Spit, burned to the ground releasing wood waste, dioxins and other toxic chemicals from treated and burned wood into the nearshore. This site has since undergone extensive cleanup and restoration activities as part of Ecology's Fidalgo and Padilla Baywide Cleanup efforts (Ecology 2019).

Current Uses

This section describes current uses occurring within the reserve, as well as current land use zoning designations affecting allowable types of uses.

DNR Authorized Uses

Projects taking place on or over state-owned aquatic lands require an authorization from DNR. DNR authorizations are legal contracts signed by both DNR and the proponent that outline the terms and conditions of the use and convey certain property rights to the user in exchange for rent or fees. DNR issues different types of use authorizations (i.e. rights-of-entry, licenses, leases, and easements) depending on the type of use. Currently, there are no DNR use authorizations within the Fidalgo Bay Aquatic Reserve. Such authorizations will only be issued in the future if they support the objectives of the reserve, fall within the Allowable Uses outlined in Section 5, and meet the terms of the conservation easement (described below).

The Conservation Easement

All of the reserve parcels donated to the state by the Skagit Land Trust in 1999 and 2006 contain a restrictive conservation easement (available on the DNR website at https://www.dnr.wa.gov/managed-lands/aquatic-reserves. Any uses must follow the conservation intent of the easement, set up "…to preserve and maintain a continuation of compatible land uses. These include public access which provides opportunity for low intensity recreation, and management and restoration of native plant communities for wildlife, open space and scenic quality..." (DNR 1999, p. 5).

Culturally Important Areas

Native tribes, including the Samish Indian Nation and Swinomish Indian Tribal Community, have continually affirmed the cultural and natural resource importance of Fidalgo Bay in its entirety.

Specifically, when asked what the most important features are to protect in the reserve, tribal representatives indicated the importance of conserving and fully restoring all of the natural elements of the bay. Traditionally, and depending on the season, shellfish gathering, crabbing and fishing for surf smelt were important in many parts of the bay. Therefore, continued water quality restoration and improvements is crucial to renewing these traditional uses, including the harvest of successfully restored Olympia oysters. The restored beaches and the associated Samish Indian Nation ownership at Weaverling Spit has become an important location for tribal events and cultural access to the bay, including annual canoe journey landings.

Recreation and Public Access

Recreation occurring within the reserve include motorized boating, kayaking, wildlife viewing, birding, clamming, crabbing, fishing, waterfowl hunting, and beachcombing. Additional activities occur along the Tommy Thompson Trail such as walking, jogging, skating, cycling, and picnicking.

The main upland public access is via one of three access points to the Tommy Thompson Trail and trestle. Minimal parking is available near the trestle. Currently, access for up to eight vehicles is available at the Samish Indian Nation's Fidalgo Bay Resort on the west end of the trestle. Although private, this is the closest parking access. The main public parking for trail access is via the City of Anacortes Parks Department's 22nd Street trailhead (located two miles west of the trestle) or the 34th

Street access trailhead (located one and a quarter miles to the west). While trail access is provided at the east trestle entrance, no public parking is available.

Boating access to the reserve can be gained via public boat launches at Washington Park (west of Anacortes) and Swinomish Channel (east of March Point), or at various marina launch facilities in Anacortes. Small non-motorized boats are often launched from Seafarers Memorial Park in Anacortes. Although much of the bay is very shallow, anchoring boats for overnight moorage is currently allowed in the reserve. A few small boats have been known to anchor temporarily on aquatic lands fronting the Samish RV Resort during summer. Larger boats may anchor outside the reserve, closer to Anacortes marina facilities. DNR anchorage rules stipulate a maximum stay of 30 days and prohibit liveaboards.

Besides the extraordinary views from the Tommy Thompson Trail, view access to the bay is best acquired from roads such as March's Point Road along the eastern boundary and Fidalgo Bay Road along the southwest boundary.

Figure 18: A trestle fire in 2009 affected 300 feet of the Tommy Thompson Trail, but has been repaired *(Photo: Trailbear—Rails to Trails Conservancy).*

In 2009, a portion of the Tommy Thompson Trail trestle caught fire, damaging about 300 feet of the trail. The section of trail was repaired by June 2010 after the community raised more than $325,000 for major repairs through efforts of the Anacortes Parks Foundation and others.

Recreational fishing, shellfish harvest, and waterfowl hunting are all allowed in Fidalgo Bay (see https://wdfw.wa.gov/). The Washington Department of Fish and Wildlife (WDFW) has authority over fishing and hunting within reserves, not DNR. As of 2018, there is currently a commercial crabbing season in the bay from March 1–April 15. Harvest levels and trends are unknown in the bay since the WDFW does not keep records of harvest specific to Fidalgo Bay.

While there are no Washington Department of Health (DOH) shellfish consumption safety monitoring sites in Fidalgo Bay, DOH does issue temporary shellfish harvest closures for the bay based on sampled biotoxins or pollution found at nearby sites. Additionally, in 2010, DOH conducted a health consultation for Fidalgo Bay to examine the potential human health effects of exposure to toxins in the bay and found elevated levels of polycyclic aromatic hydrocarbons (PAH's), along with a concern for heavy metals and dioxin (DOH 2010). The report concluding that:

- Touching, breathing, or accidentally eating sediments from Fidalgo Bay is not expected to harm the health of adults or children,

- Eating bottom fish or shellfish from Fidalgo Bay is not expected to harm the health of the general population, and
- Eating bottom fish or shellfish from Fidalgo Bay at a tribal consumption rate (higher consumption than the general population) could harm people's health.

Both the Swinomish Indian Tribal Community and Samish Indian Nation have expressed their strong desire to return Fidalgo Bay to a healthy state, enabling full fish and shellfish tribal consumption rates.

Environmental Stewardship and Research

The reserve hosts many environmental stewardship, citizen science, and research opportunities each year. Many of the activities are described in Section 4—Progress Made Toward Achieving Plan Goals. Environmental stewardship and research are a major focus of the reserve, and activities and will continue in the future.

Zoning and Land Use Designations

City and county zoning laws act to control the type of uses permitted in and around the reserve. Understanding current zoning restrictions helps inform our management approach to future proposals affecting the reserve.

Zoning of shoreline uses falls under the jurisdiction of Washington's Shoreline Management Act (RCW 90.58). This act requires local entities like cities and counties to go through a careful planning process called a Shoreline Master Program (SMP). The SMP defines acceptable shoreline use categories called *Shoreline Environment Designations* occurring in an area from extreme low tide to within 200 feet upland of the shoreline, defined by the ordinary high water mark. These designations are based on results of biological surveys, local community's goals and needs, and requirements to protect features of statewide importance. By law, each SMP must be reviewed and updated every 10 years. DNR staff provide input on draft SMP plans, urging congruency with DNR policy, legal mandates, and management objectives – including for the aquatic reserves.

The City of Anacortes SMP was completed in 2010 and applies to all shorelines of the bay under the city's jurisdiction up to the eastern trestle entrance, where Skagit County assumes jurisdiction. The city's SMP Shoreline Environment Designation for the Fidalgo Bay shoreline is "Conservancy" (Appendix C, Map C–4). The Conservancy designation is described in detail in the city's 2010 SMP and states uses will only be allowed that, "Protect shoreline functions and resources by limiting, to the extent feasible, new uses and activities in the Conservancy designation to recreational, cultural and historic uses located and designed to avoid shoreline impacts" (City of Anacortes SMP, p. 51). The city's 2010 SMP did not include any shorelines along the eastern boundary, adjacent to their Urban Growth Area. These shorelines fall under the jurisdiction of Skagit County (Appendix C, Map C–4).

While nearly complete, as of 2019 the Skagit County SMP is still a draft. The county maintains shoreline SMP jurisdiction only for lands north of the trestle on the east side of the bay. In contrast to shorelines designations falling under the city's purview, the county's draft SMP designation is "High Intensity" for this area (Appendix C, Map C–4). The draft plan states the purpose of the High Intensity designation is to "provide for high intensity water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and restoring ecological functions in

areas that have been degraded (Skagit County 2016, draft SMP, p. 12)." This designation supports the shoreline's ownership and proximity to the two petroleum refineries, as well as the March Point Road abutting the bay/reserve. For shorelines designated *High Intensity*, the draft plan stipulates that:

- Full utilization of existing urban areas should be encouraged prior to the expansion of intensive development.
- Proposals for new development in shoreline jurisdiction should be designed to result in no net loss of shoreline ecological functions.
- Where feasible, visual and physical public access should be provided.

Until the draft is final, the county is still operating under the 1976 SMP environmental designation of *Urban Shoreline*[6].

Upland zoning is controlled by Washington's Growth Management Act. The City of Anacortes zoning applies to lands within city limits, including much of the uplands to the west and south of the reserve, and also the city's March Point Urban Growth Area, east of the reserve. For a map of current upland zoning see Appendix C, Map C–5. Uplands more than 200 feet from the shoreline near the reserve are zoned "Commercial Marine" (areas west of Weaverling Spit), "Light Manufacturing 1" (south of trestle), or "Heavy Manufacturing" (in the city's March Point Urban Growth Area, north and east of the trestle). The Light Manufacturing zone allows for single family residences as conditional uses. Commercial Marine allows multi-family residential as a conditional use, providing "it can be demonstrated that the uses will not weaken the district's tourist or marine-oriented purpose, nor diminish the marine values inherent in the district such as physical and visual access to waterways and shoreline" (Anacortes Municipal Code Chapter 7, Section 21 (2008)). New residences are not allowed in the March Point Heavy Manufacturing zone.

Presently, three or four single-family residences are located along the eastern shore from Little Crandall Spit to the vicinity of the trestle's east entrance. A small RV park is located on Little Crandall Spit and livestock are grazed in the fields across the road from the trestle entrance. Otherwise, petroleum refinery infrastructure occupy the eastern shoreline and upland parcels. A few commercial businesses are located along the southwestern shoreline, along with a handful of single-family residences and a condo complex. A unique, 9-acre undeveloped rocky forested promontory on the south shoreline directly north of the Highway 20 spur intersection is currently (2019) for sale. The Fidalgo Bay Resort, with cabins and RV hookups is located on Weaverling Spit.

Future Land Use Changes and Stewardship

As the population of Skagit County, tourism and the local economy continues to grow, changes will inevitably occur which may affect the reserve, and the bay itself. Anticipated future "drivers" of these changes were described under Potential Drivers of Future Change in Section 2, along with ecosystem stressors connected in various ways to land use changes.

[6]The Urban Shoreline Area is a shoreline area of intensive development including, but not limited to residential, commercial, and industrial uses. Areas suitable are those presently subjected to intensive use as well as those planned to accommodate urban expansion. (Skagit County 1976).

4. Progress Made Toward Achieving Plan Goals

This section details the progress made in the past 10 years toward achieving the 2008 Management Plan goals. It represents a record of the invaluable work, partnerships and types of activities conducted during this time frame.

Prior to establishment of the reserve in 2008 many groundbreaking and successful projects were initiated or completed in and adjacent to Fidalgo Bay, supporting the plan's objectives. This important work included removal of large quantities of creosote from the Tommy Thompson Trail, Crandall Spit, Weaverling Spit and other locations; beach enhancement and restoration of forage fish habitat along sections of the shoreline North and East of the trestle; reintroduction of Olympia oysters in multiple places within the reserve; and completion of various intertidal, eelgrass, forage fish and bird surveys. Since these activities were completed prior to adoption of the 2008 plan, details are not provided below.

Partners and Projects Accomplished 2008–2018

Major support for work in the reserve has come from: The Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee, the Skagit Marine Resources Committee, The Samish Indian Nation, RE Sources for Sustainable Communities, the Friends of Skagit Beaches, the Skagit Land Trust, and the City of Anacortes Parks and Recreation Department. Both Shell and Tesoro (now Marathon) have provided funding in support of multiple projects through these partners.

Figure 19: Beach seine demonstration at Fidalgo Bay Day *(DNR photo).*

Since its creation in 2012, the Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee (CSC) has provided initiative and essential support toward achieving the reserve management goals. The CSC is a volunteer group comprised of local community members with a strong interest in citizen science, environmental education, and conservation of the reserve. The group helps garner support for the reserve, providing a local point of contact and an information conduit with DNR on issues affecting the reserve. CSC-sponsored citizen science projects have included yearly intertidal monitoring at four sites, seasonal shore-based marine bird surveys at four sites, and forage fish beach spawning surveys on both sides of the bay. The CSC also conducts outreach, beach clean-ups, assists with events such as the annual Fidalgo Bay Day, hosts shoreline interpretive walks, and raises awareness of important issues affecting the reserve, like stormwater management. From 2013–15, the CSC was supported by a grant from EPA's National Estuary Program (NEP) managed by the Washington Environmental Council. Continued support was provided by a second EPA National Estuary Program grant from

2016-2018 managed by DNR. RE Sources for Sustainable Communities, a local non-profit organization, has been a fiscal sponsor providing staff support for the CSC's many efforts since 2013.

Since 1999, the Skagit Marine Resources Committee (MRC), funded through the Northwest Straits Commission, has provided many educational, citizen science, and habitat restoration support functions in Fidalgo Bay. The MRC is the lead organizer for Fidalgo Bay Day, with the Samish Indian Nation sponsoring the venue. Fidalgo Bay Day is a community event focused on environmental education, responsible beach etiquette and maintaining healthy habitats for creatures in the bay. This one-day event has occurred annually since 2004. The MRC also sponsors a "Kids on the Beach" initiative to educate K-12th graders about forage fish. The Skagit MRC trains volunteers in citizen science through their Salish Sea Stewards program, supported by funding from Friends of Skagit Beaches. The MRC has provided expertise, staffing and fiscal support for the successful reintroduction of the Olympia oyster in the bay for many years.

Figure 20: Fish biologist Dan Penttila sharing knowledge at Fidalgo Bay Day *(DNR photo).*

The Samish Indian Nation has supported reserve goals through collaborative projects with state and federal agencies; through tribal research and monitoring projects, for example water quality, forage fish, and nearshore fish use (beach seining); and through direct conservation actions like creosote wood removal and cleanups. Their restoration of more than 1,600 linear feet of beach and riparian areas along Weaverling Spit provides a major habitat enhancement of lands immediately adjacent to the reserve. The Samish Indian Nation also commissioned a valuable feasibility study to model the hydrologic effects of various causeway and trestle removal scenarios. (Ridolfi 2008). This study provides important information for potential future habitat enhancements in the southern half of the reserve.

Friends of Skagit Beaches (Friends), a local non-profit volunteer-run organization has also provided support of reserve goals for many years. They received a grant from the Washington Department of Ecology to create a "Trail Tales" shoreline interpretive program from 2011–2015. Friends offered Trail Tails interpretive walks, using 17 different interpretive signs created and installed by Friends along the Tommy Thompson Trail from 34th street trailhead to March Point. DNR staff partnered with Friends on several signs and co-led interpretive walks in the reserve.

The City of Anacortes Parks and Recreation Department has provided important support for the primary access to the reserve via the Tommy Thompson Trail. Through the creation of trailheads, parking and interpretive signage, regular maintenance, and emergency response and management, Anacortes Parks creates long-term opportunities for the community to enjoy the reserve.

Figure 21: Interpretive station highlighting citizen science intertidal monitoring on tidelands adjacent to the Tommy Thompson Trail *(DNR photo*).

Besides the partners mentioned above, various researchers, organizations and agencies have also contributed to our knowledge of the reserve. These include researchers from academic institutions like Western Washington University and University of Washington–Tacoma. Additional research is conducted by DNR's Nearshore Habitat and Aquatic Assessment and Monitoring Teams.

The Washington Department of Ecology (Ecology) is conducting an ongoing bay-wide cleanup of contaminated sites outside of the reserve, with mitigation and restoration actions that will strengthen and improve the long-term ecosystem health of the reserve. In particular, cleanup of wood waste and other contaminants at the Custom Plywood mill site to the northwest of the reserve, along with associated eelgrass plantings and creation of a pocket estuary contribute to a healthier reserve.

Completed and Ongoing Activities

Tables 1–3 below illustrate activities carried out in the past decade in support of the 2008 reserve management plan goals. The activities in each table support a specific 2008 plan goal, although some may have been initiated well before 2008. Activities may support multiple goals. However, for simplicity each activity is listed just once under the assumed primary goal the activity supports. This information was gleaned from various sources, and this record may be incomplete.

Activities in Table 1 primarily support the reserve goal of *preserving, restoring and enhancing natural ecosystem function and processes in the reserve.* Projects have included: beach enhancements to bring in natural materials for habitat purposes, removal of creosote treated wood, planting of native eelgrass, re-introduction of native shellfish, and regional modelling assessments to identify restoration and protection priorities.

Table 1. Completed activities in or near the reserve supporting the 2008 goal of preservation, restoration and enhancement of natural ecosystem function and processes.

Activity	Description	Lead Organization	Event Completion Year(s)**
Fidalgo Bay Causeway Feasibility Study Report	Report assessing the technical feasibility and benefits of different removal options for the trestle and causeway.	Samish Indian Nation, DNR, City of Anacortes	2008
Beach habitat restoration	Beach restoration & shoreline enhancement (phases 1, 2 and 3) at Weaverling Spit: Restored approximately 1,600 ft. of shoreline	Samish Indian Nation	2014–2017
	West March Point beach enhancement/forage fish habitat restoration	Skagit River System Cooperative, Tesoro, Skagit Marine Resources Committee (Skagit MRC), DNR	2010, 2011, 2012
	Northwest March Point Beach Nourishment Project. Gravel nourishment of more than 500 ft. of shoreline on private tidelands	Skagit MRC, Northwest Straits Initiative	2014
	Invasive plant and green crab surveys	Samish Indian Nation, Washington Dept. of Fish and Wildlife (DFW), Washington Sea Grant, Skagit County	Ongoing 2017– present
Beach riparian restoration	Removal of structures and riparian restoration, southwest side of Fidalgo Bay.	Skagit Land Trust	Ongoing 2017–present
Spill contingency planning & response	Geographic Response Plan for oil spill response: North Puget Sound GRP was completed 2012, currently being updated	Washington Dept. of Ecology (Ecology), industry, tribes	2012
	Spill response equipment and training for Samish Indian Nation (Ecology Oil Spill Response Team)	Ecology, Samish Indian Nation	2018, ongoing
Eelgrass restoration	Scott Paper Mill remediation site – planted eelgrass meadow is successfully established and expanding on tidelands adjacent to the reserve.	Port of Anacortes, Ecology	???
Riparian and nearshore toxics cleanup and restoration	Custom Plywood site. Cleanup, remediation and enhancement of nearshore & riparian location just north of the reserve. Removal of wood waste and toxics from the uplands and nearshore, construction of pocket estuary.	Ecology	Ongoing 2013–present
Olympia oyster research	Olympia oyster larval dispersal studies (Shawn Arellano WWU, Bonnie Becker UW Tacoma)	WWU Shannon Pt., UW Tacoma	??

Activity	Description	Lead Organization	Event Completion Year(s)**
	Long-term/ongoing Olympia oyster restoration projects in multiple locations in reserve (project began in 2002)	Skagit MRC, Puget Sound Restoration Fund	Ongoing 2008 –present
Outfall improvement & pollution reduction	Samish Indian Nation outfall data used to upgrade, addressing problems in cooperation with City	Samish Indian Nation	Ongoing 2015 –present
Marine debris & creosote removal	Creosote Inventory & Removal Project	Skagit MRC	2008, 2009
	Marine debris and creosote removal.	Samish Indian Nation	Ongoing 2014 –present
	Marine debris survey (NOAA protocols)	PugetSound Corps	2016
	Marine debris cleanup (during regular forage fish surveys)	PugetSound Corps	2012–2016
Fidalgo Bay Salt Marsh Restoration Feasibility Study	Report assessing options, feasibility and benefits to restoring saltmarsh habitat, located south of the Samish RV Park in south Fidalgo Bay.	Samish Indian Nation	2014
Assessment & prioritization	March Point Geomorphic Assessment & Drift Cell Restoration Prioritization (Coastal Geologic Services)	Skagit MRC	2007
	Marine Shoreline Protection Assessment (Odden 2014)	Skagit MRC, Skagit Land Trust	2014
	Watershed Characterization Volume 2: Fish and wildlife habitat assessment (Wilhere et al. 2013).	Ecology, DFW	2013

Activities in Table 2 primarily support the reserve goal of *inventorying native habitats, focusing on mudflats, sand flats, forage fish spawning areas and eelgrass.* Projects have included repeated eelgrass monitoring and forage fish spawning surveys, fish seining, intertidal and bird surveys, water quality and stormwater monitoring, contaminant and ocean acidification surveys.

Table 2. Completed activities supporting the inventory of native habitats and species (with focus on mudflats, sand flats, forage fish spawning, and eelgrass).

Activity	Description	Lead Organization	Event Completion Year(s)**
Inventory (or monitoring?)	Clam surveys (temp., md & creosote	Samish Indian Nation	2009, Ongoing 2015–present
Nearshore fish surveys	Beach seining for salmonids & small fish	Samish Indian Nation	Ongoing 2016 –present

Activity	Description	Lead Organization	Event Completion Year(s)**
Eelgrass monitoring	Repeat eelgrass transect surveys	DNR Submerged Vegetation Monitoring Program	2008, 2009–2013, 2016, 2018
	Samish Indian Nation eelgrass transects in a cooperative study with Padilla Bay NERR	Samish Indian Nation	2017, 2018
Water quality monitoring	Fidalgo Bay Contamination Study (stormwater monitoring)	Skagit Marine Resources Committee (MRC), Samish Indian Nation	2007–2009
	Monitoring outfall water quality into the bay (began 2005)	Samish Indian Nation	Ongoing 2008–present
	Continuous temperature monitoring	Samish Indian Nation	Ongoing 2009–present
	Water quality monitoring stations (ANeMoNe) – continuous data collection of dissolved oxygen, pH, salinity, temp, chlorophyll, etc	DNR Aquatic Assessment and Monitoring Team	Ongoing 2015–present
	Puget Sound Mussel Watch (cages with mussels to measure contaminants)	WDFW, DNR Aquatic Reserve Program staff, Samish Indian Nation	Winter 2012/13, 2015/16, 2017/18
Bird surveys	Shore-based marine bird surveys (monthly Sept-May)	Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee (CSC), Skagit Audubon	Ongoing 2017–present
	COASST surveys	University of WA. - Julia Parish; DNR Puget SoundCorps, Samish Indian Nation	Since 2014
	Great Blue Heron studies/citizen science (since 2002)	Skagit Land Trust, Friends of Skagit Beaches, Skagit County Heron Forage Monitoring Team	Ongoing 2008–present
Forage fish surveys	Forage fish spawning surveys	WDFW, Salish Sea Biological, CSC, DNR Puget SoundCorps	2008–2012 Ongoing 2012–present
Intertidal surveys	Intertidal monitoring citizen science project	CSC, Anacortes Public Schools, WWU	Ongoing 2013–present
Sediment cleanup & monitoring (adjacent to reserve)	Site cleanup, biological and physical monitoring Scott Paper Mill and Custom Plywood (eelgrass, upland veg, forage fish, intertidal, salmonid).	Department of Ecology (Ecology)	Cleanup completed 2012

Activity	Description	Lead Organization	Event Completion Year(s)**
	Custom Plywood site. Ongoing monitoring of forage fish spawning and salmonid habitat, intertidal area, upland riparian vegetation.	Ecology	Ongoing, final cleanup to be completed 2019
Shellfish larvae recruitment in eelgrass beds	Comparison of larval shellfish recruitment within and outside of eelgrass beds (associated with ANeMoNe project).	DNR Aquatic Stewardship Science staff	2017, 2018
Study & prioritization	Fidalgo Bay circulation study (funded by Samish Indian Nation)	USGS—Eric Grossman	2013

Figure 22: A shell enhancement plot established along the east side of Fidalgo Bay by Puget Sound Restoration Fund in 2013. A cultch shell monitoring bag is in the foreground *(Photo: 2018 Olympia oyster report.).*

Figure 23: Heavy Olympia oyster natural recruitment on a shell enhancement plots observed in 2016. The recruits are oysters that settled in the summers of 2014 and 2015 *(Photo: 2018 Olympia oyster report.).*

Activities in Table 3 primarily support the reserve goal of *environmental education and outreach.* Projects have included: citizen science activities like intertidal monitoring, bird surveys, and forage fish sampling, classroom presentations; hands-on interpretive events on the beach; volunteer trainings; educational booths at festivals; and creating interpretive signs.

Table 3. Completed activities supporting Environmental Education and Outreach

Activity	Description	Lead Organization	Event Completion Year(s)**
Beach clean-up	Beach clean-up opportunities	Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee (CSC), NOAA, Surfrider Foundation	2013–present
	Crandall Spit beach cleanup	Shell, Friends of Skagit Beaches (Friends), RE Sources	2018
Citizen science	Avian monitoring citizen science opportunity	CSC	Ongoing 2017–present
	Forage fish survey, monitoring and lab work—citizen science opportunity	CSC	Ongoing 2013–present
Classroom presentation	Salish Sea Stewards classroom presentation about DNR's Aquatic Reserves program, how to volunteer in the reserves.	Skagit Marine Resources Committee (MRC), DNR Aquatic Reserves Program	Ongoing 2013–present
	Skagit Watershed Masters—class demonstrations	CSC, Skagit Conservation District	Ongoing 2013–present
School field trips	"Kids On The Beach" forage fish education for K–12 students in the field	MRC, Sea Doc Society, CSC, Friends	Ongoing 2017–present
Educational display/activities	Created stormwater educational PowerPoint and display materials and presented to local civic groups.	CSC, City of Anacortes, Friends of Skagit Beaches (Friends)	2015–present
	Fidalgo Bay Day—including displays, interactive games, mobile touch tank, beach seine demonstration	CSC, MRC, Friends, Puget Sound Corps	Ongoing/ annually 2004–present
	Fidalgo Shoreline Academy booth educating the public about the reserve & CSC (focus areas vary by year).	CSC, Friends	Ongoing annually 2013–present
	Skagit Bald Eagle Festival - talk, booth, and forage fish activities	CSC, Concrete Chamber of Commerce	Ongoing/ Annually 2015–2018
	Science on the Bay – Science Symposium featuring work by scientists and citizen scientists in Fidalgo Bay Aquatic Reserve	CSC	2018
Advocate for bay wide water quality improvements	Comment on development proposals in support of low impact development planning for projects in the Fidalgo Bay watershed (Anacortes High School rain garden, HWY 20 roundabout)	CSC, Anacortes School District, WSDOT, Samish Indian Nation, MRC, City of Anacortes	2014–2018

Activity	Description	Lead Organization	Event Completion Year(s)**
Public workshop	Shoreline Land Owner Workshops (MRC)	MRC	2015–2018
Citizen science	Opportunities for students to participate in intertidal monitoring events	CSC, Anacortes Public Schools, WWU	Ongoing 2013–present
Hands-on interpretive stations	Forage fish education for students and the public at forage fish monitoring events.	MRC, CSC, Friends,	Ongoing 2017–present
	Use of educational stations at forage fish and intertidal monitoring events.	CSC, Friends	Ongoing 2015–present
Interpretive signs, associated interpretive walks	Installed 17 interpretive signs along the trestle portion of Tommy Thompson trail (34th St. entrance to March Point). Interpretive walks with docents interpreting signage along the trail. Created websites with matching story and video content.	Friends, City of Anacortes, CSC, DNR staff	2012–2015
	Creation and installation of road signs that clearly identify the aquatic reserve.	CSC, City of Anacortes, WSDOT, DNR Aquatic Reserves Program	2015

Administrative Support

Aquatic Reserve management by DNR also includes the administrative support necessary to accomplish the stated goals. Such work includes providing ongoing support to the Citizen Stewardship Committee through grant proposals and administration (for example, the 2016–18 EPA National Estuary Program grant); creating signs, maps, videos, brochures and interpretive materials; maintaining and updating websites; coordinating with partners; and participating in outdoor education and citizen science.

Land Acquisition/Transactions for Habitat Conservation

Approximately two-thirds of the current reserve area was originally protected through acquisition by the Skagit Land Trust in the early 2000s. These aquatic land parcels have a Conservation Easement placed on their deed stipulating they can only be used for conservation purposes. In 2016 the Skagit Land Trust acquired a 1-acre residential shoreline property just south of Weaverling Spit and adjacent to the Reserve. The structure was removed and the site is being planted with native species to restore riparian conditions.

Achievement of 2008 Plan Goals and Lessons Learned

Some of the 2008 Management Plan goals that were not realized include assessing salmonid use in the reserve, developing monitoring plans to evaluate trends in the reserve, regularly surveying for Threatened and Endangered Species, and reducing the amount of shoreline alteration in the bay.

Following establishment of the Fidalgo Bay Aquatic Reserve, DNR management focused on responding to urgent issues on reserves as well as establishing five new reserves. Some of the aspirational goals of the original management plan were beyond the scope of what the program could address alone, such as significantly reducing the amount of shoreline alteration. The need for monitoring Threatened and Endangered species surveys turns out to be minimal, since these species are not generally found in the reserve. Monitoring plans were developed in conjunction with citizen science projects, and system-wide projects like forage fish monitoring. The program did not have capacity to also develop trend monitoring plans.

During the next ten years, DNR may be able to support juvenile salmonid assessments, and develop more robust monitoring plans in conjunction with partners. The 2008 Threatened and Endangered Species survey goal is now wrapped into the general species and habitats goals.

It should be noted that within this time-frame, both Ecology and the Samish Indian Nation carried out major restoration activities on lands adjacent and northwest of the reserve, with actions congruent with reserve goals.

5. Management Guidance

The Fidalgo Bay Aquatic Reserve is established as an environmental reserve to protect and restore important native ecosystems, to foster environmental stewardship, and to facilitate collaborative partnerships. This section of the plan identifies the long-term vision for the reserve and provides goals and objectives to support this vision. The management guidance was developed collaboratively with reserve stakeholders through public meetings and written feedback during the 10–year management plan update process.

Long-Term Vision

The long-term vision describes the overall target or ideal conditions through the 90–year term of the aquatic reserve. The vision provides a framework for developing the management goals and conditions.

Over the 90–year term of the reserve, the Management Plan ensures strong protection of the state-owned aquatic lands to prevent further habitat degradation and to enhance the natural character of the bay. Natural processes and functions that support a healthier nearshore environment will be restored. Shoreline restoration will lead to improved habitats for native species and enhance spawning, refuge and rearing fish habitat. Improved ecological conditions will also promote foraging opportunities for resident and migratory birds and marine mammals.

Partnerships with adjacent landowners and land managers are essential to address potential impacts from conditions adjacent to Fidalgo Bay Aquatic Reserve. Efforts will focus on reducing water quality impacts to the aquatic reserve and the adjacent nearshore areas, improving riparian shoreline characteristics, and supporting permanent restoration of Olympia oysters.

Fidalgo Bay Aquatic Reserve will also be an essential resource to the community for environmental education, research, monitoring, recreational and cultural use, as well as aesthetic enjoyment of scenic views.

Goals

The following management goals have been established for the Fidalgo Bay Aquatic Reserve:

1) **Natural functions and processes**: Protect, enhance and restore the natural functions and processes of nearshore ecosystems.
2) **Native habitats and species**: Conserve and enhance native aquatic habitats and species with an emphasis on conservation priorities.
3) **Monitoring and research**: Gather and assess ecological and human use information to support adaptive management decisions.
4) **Environmental education, stewardship, and partnerships**: Promote stewardship of the aquatic reserve by facilitating environmental education and citizen science, strengthening community partnerships, and promoting public use.

5) **Authorized uses**: Ensure that any authorized uses of state-owned aquatic lands in the reserve are consistent with the aquatic reserve's long-term vision and management goals, and the conservation easement.

Objectives and Strategies

Goal 1: Natural functions and processes *Protect, enhance and restore the natural functions and processes of nearshore ecosystems.*	
Objectives & Strategies	
1.1	**Nearshore processes and drift cells** – Maintain or enhance nearshore processes, proper drift cell function, and sediment movement.
	a) Work with partners, adjacent landowners and adjacent land managers to remove bulkheads and reduce shoreline modification
	b) Evaluate barriers to sediment movement, such as the revetment/causeway, and propose restoration or enhancement solutions
1.2	**Restoration and enhancement** – Restore and enhance impaired or degraded native nearshore habitat and natural processes.
	a) Coordinate with tribes and partners to identify and prioritize restoration projects, develop restoration plans and seek funding
	b) Work with tribes, the City of Anacortes, and partners to remove the causeway, railroad trestle and associated creosote pilings while maintaining a pedestrian trail by replacing with a climate-resilient, non-polluting structure that allows tidal exchange and improved water circulation
	c) Restore and enhance shoreline habitat and processes through removal of shoreline modifications, planting of native vegetation in backshore areas, and beach nourishment to improve sediment/substrate availability
	d) Remove creosote piles and other derelict structures from Fidalgo Bay (These are mostly in the northeast part of the reserve)
	e) Work with tribes and partners to remove marine debris, derelict crab pots and fishing gear, and reduce plastics
	f) Work cooperatively with adjacent landowners, on a voluntary basis, to identify and address specific habitat restoration and conservation opportunities
1.3	**Land acquisition** – Encourage protection of important nearshore habitats by working with partners to acquire adjacent tidelands, encouraging placement of lands into protective status, and acquiring additional reserve lands directly through donation.

Goal 1: Natural functions and processes *Protect, enhance and restore the natural functions and processes of nearshore ecosystems.*	
1.3 (ctd.)	a) Encourage placement of important upland and aquatic habitats adjacent to the reserve into conservation easements
	b) Work with Skagit Land Trust and other partners to establish priorities for land acquisition and conservation easements
	c) If aquatic lands directly adjacent to the reserve come into state ownership, DNR can choose to include these areas in the aquatic reserve

Goal 2: Native habitats and species *Conserve and enhance native aquatic habitats and species with an emphasis on conservation priorities.*	
Objectives & Strategies	
2.1	**Native habitats** – Protect and restore the documented extent and diversity of native aquatic vegetation, mudflats, salt marsh and other important habitats.
	a) Identify and support enhancement and restoration projects that would benefit aquatic vegetation, salt marsh and other important habitats
	b) Partner with tribes and landowners to identify habitat protection opportunities adjacent to the reserve
	c) Promote and support research projects that focus on long-term trends, human impacts to native habitats, stressor response and causes of local declines
	d) Monitor trends in eelgrass coverage, understand reasons for eelgrass decline in certain areas, and identify opportunities for eelgrass recovery
2.2	**Fish habitat** – Protect fish spawning and rearing habitat, and movement corridors with a focus on surf smelt, sand lance, herring and salmon.
	a) Identify impaired habitats that would contribute to forage fish or salmonid survival if habitat functions were enhanced or restored such as degraded beaches and pocket estuaries (Big Crandall Spit, Samish Tribe living marsh project by Weaverling Spit)
	b) Improve forage fish spawning habitat by planting native shoreline vegetation to increase shading
2.3	**Waterbird habitat** – Protect nearshore waterbird habitat areas and maintain undisturbed habitats where birds can feed, breed, and overwinter.

Goal 2: Native habitats and species *Conserve and enhance native aquatic habitats and species with an emphasis on conservation priorities.*	
2.3 (ctd.)	a) Protect and restore specialized nearshore habitats, such as mudflats, pocket estuaries and salt marshes
	b) Identify and monitor activities that have the potential for disturbing foraging and nesting waterbirds
2.4	**Native species** – Enhance habitats and protect native species through restoration projects and control of invasive species.
	a) Work with Skagit MRC, tribes and other partners to support Olympia Oyster restoration
	b) Support ongoing surveys, with a focus on early detection, and control of European green crabs, *spartina* and other aquatic nuisance and invasive species
2.5	**Water quality** – Promote and support partnerships focused on improving water quality that reduce impacts to sensitive species and habitats.
	a) Coordinate with partners, such as City of Anacortes, Samish Indian Nation, and Citizen Stewardship Committee, to identify and address sources of water quality impairment, including stormwater and non-point sources
	b) Work with municipalities and industries to ensure water quality standards are met (e.g. NPDES)
	c) Work collaboratively with the Department of Ecology and industries to ensure adequate spill response coordination and planning
2.6	**Climate change adaptation and resiliency** – Cooperate with tribes and partners to advance climate change adaptation planning and coastal resilience.
	a) Coordinate with tribes and partners to conduct a vulnerability assessment to identify potential climate change impacts, especially related to sea-level rise and ocean acidification
	b) Identify and pursue opportunities to enhance ecosystem and coastal resilience
	c) Incorporate sea-level rise and other climate change adaptations into long-term planning efforts associated with the reserve
	d) Increase monitoring efforts to identify key early indicators of climate change so that the reserve can act as sentinel site to track environmental change associated with climate change in the region
	e) Identify opportunities to reduce non-climate-related stressors to the reserve, such as: removing creosote pilings, reconstructing the causeway and trestle, and protecting undeveloped land to allow beach migration

Goal 3: Monitoring and Research

Gather and assess ecological and human use information to support adaptive management decisions.

Objectives & Strategies	
3.1	**Data gaps and data organization** – Identify data gaps and improve access to data and research results.
	a) Update and refine baseline inventory of aquatic habitats and species that use the reserve area, and shoreline access points
	b) Coordinate with partners to inventory data and identify gaps, and then prioritize strategies to address the gap
	c) Coordinate monitoring and research efforts with tribes, local and state agencies, local nonprofits, universities and citizen science groups
3.2	**Assessment, baseline inventory and trend monitoring** – Conduct, facilitate and support inventory and monitoring programs to guide management.
	a) Focus forage fish monitoring efforts on egg survival, habitat improvement, shoreline vegetation and shading, identifying sand lance spawning habitat, and trends in spatial distribution of spawning habitat, water quality and stormwater
	b) Conduct pre and post–restoration monitoring to improve adaptive management and use to prioritize future restoration projects
	c) Coordinate with adjacent land owners to increase access to survey sites
3.3	**Research** – Promote and support research within the reserve with an emphasis on climate change impacts, emerging science and studies with management applications.
	a) Support research that focuses on conservation priorities identified in this plan
	b) Promote and support research that focuses on the potential effects of climate change (sea-level rise, ocean acidification, changes in water temperature and salinity) on the resources within the reserve
	c) Support research that focuses on reserve efficacy, site-comparisons of the aquatic reserve network, and other marine protected areas in Puget Sound
3.4	**Reserve work plan** – Develop a management and tracking tool for tracking reserve projects.
	a) Keep current spreadsheet of specific tactics and projects, responsible parties, timelines and contacts
	b) Update work plan annually with stakeholder group

Goal 4: Environmental education, stewardship and partnerships

Promote stewardship of the aquatic reserve by facilitating environmental education and citizen science, strengthening community partnerships, and promoting public use.

Objectives & Strategies	
4.1	**Education and stewardship** – Increase public awareness and stewardship of the reserve through environmental education, outreach, and citizen science.
	a) Support the Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee and other partners conducting environmental education, outreach and citizen science
	b) Promote education programs that engage the public in reserve stewardship and increase understanding of the importance of ecological, geologic, cultural and historic components of Fidalgo Bay
	c) Promote and support citizen science that fills data gaps, establishes long-term trends and increases stewardship of the reserve
	d) Maintain interpretive signs and assess the need for additional signage to increase awareness of the reserve
	e) Work with tribes to develop educational materials that incorporate cultural and historical topics and current environmental stewardship opportunities
4.2	**Stewardship & community values** – Foster public engagement, stewardship and volunteerism that promotes community and cultural values.
	a) Protect cultural resources, traditional uses and partner with tribes to promote public awareness of cultural values
	b) Integrate historic and cultural uses of Fidalgo Bay pre and post contact in outreach materials
	c) Incorporate community uses and values in outreach and education programs to increase stewardship and sense of ownership of the reserve
	d) Conduct surveys to understand the public use and values related to Fidalgo Bay (potential CSC project)
4.3	**Partnerships** – Develop partnerships with tribes, local and state governments, universities, local schools, nonprofits, local businesses and citizens to increase the Aquatic Reserve Program's effectiveness.
	a) Organize annual stakeholder meeting to evaluate progress and plan for the coming year of plan implementation
	b) Work cooperatively with partners to develop outreach and education materials and to install interpretive signage

Goal 4: Environmental education, stewardship and partnerships *Promote stewardship of the aquatic reserve by facilitating environmental education and citizen science, strengthening community partnerships, and promoting public use.*	
4.3 (ctd.)	c) Collaborate with partners to identify and fund potential enhancement and restoration activities that will support the aquatic reserve
	d) Work with local entities to ensure designations and programs under both the Shoreline Management and the Growth Management Acts support the goals and objectives of the reserve.
	e) Work with WDFW and tribes to create better understanding of management and harvest of key marine species in the reserve such as herring, forage fish, and Dungeness crab.
4.4	**Public access** – Foster sustainable use and public access to state-owned aquatic lands within and adjacent to the reserve.
	a) Collaborate with adjacent land owners and managers to provide safe public access
	b) Provide information on public access areas, including installation of identification signs
	c) Inventory types and impacts of recreational and other human use activities, and work cooperatively with partners to manage use and reduce human impacts

Goal 5: Authorized Uses *Authorized uses on state-owned aquatic lands must be consistent with the aquatic reserve long-term vision and management goals and the conservation easement. The DNR Orca Straits District and Aquatic Reserves Program review proposed uses that are authorized through the JARPA permit process.*	
Objectives and Strategies	
5.1	**Allowable uses** – DNR will review applications for all new uses of state-owned aquatic lands within or directly adjacent to the reserve, and will only consider the following uses: • Public access that provides opportunity for low intensity recreation and sustainable use where consistent with the long-term vision and management goals; • Ecological monitoring if conducted under a monitoring plan approved by DNR; • Research in support of the reserve's goals and objectives; and • Restoration projects that are consistent with the management of the reserve and conducted under a restoration plan approved by DNR.

Goal 5: Authorized Uses

Authorized uses on state-owned aquatic lands must be consistent with the aquatic reserve long-term vision and management goals and the conservation easement. The DNR Orca Straits District and Aquatic Reserves Program review proposed uses that are authorized through the JARPA permit process.

5.1 (ctd.)	a) DNR will perform a critical review of new use proposals pursuant to WAC 332-30-151 and make a determination about the consistency of the proposed use with the reserve management guidance
	b) Ensure proposed new uses meet or exceed DNR's Aquatic Habitat Stewardship Measures
	c) DNR will work with partners to ensure restoration projects and monitoring plans are consistent with the reserve goals and for adaptive management
5.2	**Prohibited uses** – DNR will not authorize any uses that do not comply with the strategies in 5.1 (allowable uses) above.
	a) Any uses proposed on state-owned aquatic lands adjacent to the reserve must not conflict with the purpose of the reserve designation and specifically with the habitat and species identified for conservation within the reserve
	b) Unauthorized uses must be removed by the owner
	c) DNR will remove the unauthorized use when the owner cannot be identified and funding sources are av7ailable

6. Implementation Guidance

The successful management of the Fidalgo Bay Aquatic Reserve requires coordination and collaboration with public and private entities as well as local, state, federal, and tribal government, and non-government organizations. Review and evaluation of sound scientific and management information will guide future development, restoration and protection decisions in the reserve.

Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee (CSC)

Currently, the Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee (CSC) meets monthly to collaborate on projects, events, and provide input to DNR on reserve management. The CSC is composed of representatives from various groups interested in the reserve, and residents at large. The results of their many initiatives and projects are well documented in other sections of the plan. The CSC also provides a critical and regular conduit of information between local interests and DNR.

Figure 24: Members of Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee and DNR staff.

Fidalgo Bay Aquatic Reserve Stakeholder Group

Based on interest expressed by participants during the update of this management plan, DNR will begin convening an annual Fidalgo Bay Aquatic Reserve Stakeholder meeting to increase collaboration and decision-making about the reserve. The stakeholder group represents a larger, more diverse group of participants than the CSC with a broad array of interests and perspectives. The annual meeting will help guide implementation of this plan and coordinate stewardship strategies that may improve and protect the long-term health of the Fidalgo Bay ecosystem.

The stakeholder group will advise and assist with the cooperative implementation of this management plan. This may include:

1. Identifying partnerships for implementing management actions;
2. Recommending and evaluating proposals for restoration, research, monitoring, and educational needs, with emphasis on results that will facilitate collaborative adaptive management; or
3. Evaluating and considering potential sources of funding for implementing management actions.

The group is not required to operate on consensus, and DNR will consider comments from individual group members. The stakeholder group will meet annually, with at least one interim email update. The group includes approximately 32 members from a broad spectrum of representation, including:

- Adjacent landowners/residents;
- Scientific community, including Western Washington University, Shannon Point Laboratory, and local scientists;
- Skagit Marine Resources Committee;
- Environmental non-profit organizations, such as ReSources for Sustainable Communities, Skagit Land Trust;
- Local industries, including Shell and Marathon representatives;
- Local and State Government, including City of Anacortes, Port of Anacortes, Skagit County, WA Department of Fish and Wildlife;
- Tribal government, including Samish Indian Nation and Swinomish Indian Tribal Community; and
- Community groups, including Fidalgo Bay Citizens Stewardship Committee.

Potential new members will be invited to join the group by means of formal invitation, either by email or by letters.

Fidalgo Bay Aquatic Reserve Work Plan

Stakeholder identified priority strategies during the April 20, 2019 meeting and these were incorporated into a draft two-year work plan and tracking tool for the reserve (Appendix D.) The work plan helps reserve staff, volunteers and partners grasp logical next steps for beginning and completing important projects for the reserve.

Vision for the Future: Collaborative Adaptive Management

In the first ten years since the reserve's establishment, DNR and partners have learned a great deal about the status of species and ecosystem function in the reserve. Over the next ten-year period, we plan to collaborate with researchers and partners to refine monitoring objectives to understand how proposed restoration actions may affect the reserve. The stakeholder group can help with this process by identifying, on an annual basis, the key resources and issues that management should focus on and learn about in the next decade. Management decisions will be made based on objective data developed by a group of partners focused on shared goals and a willingness to adapt to new information. Meanwhile, the Citizen Stewardship Committee's regular meetings and organized efforts throughout the year provide on-going monitoring, communication with DNR staff, and essential education for building long-term support for the reserve.

DNR believes that collaborative partnerships are vital to the reserve management and strategy implementation. Excellent stewardship and management of a reserve stems from a close working relationship with the community, stakeholders, agencies, Tribes and non-profit organizations. The work of program staff can be leveraged through volunteer organizations, grants, and local partners. High quality monitoring programs can be developed and research conducted with the support of

university and college faculty that use and support the reserve. All these efforts lead to synergy among project partners and positive outcomes for both the site and the community that surrounds it.

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Note: This reference section contains all references cited, including those in Appendix A.

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Appendix A – Fidalgo Bay Site Characteristics

Detailed Table of Contents

Appendix Organization

The Fidalgo Bay Aquatic Reserve contains diverse physical habitat areas that include emergent salt marsh, sand and gravel beaches, mud, and extensive tidal flats and eelgrass beds. These habitat areas are recognized as essential contributors to the reproductive, foraging, and rearing success of many fish, invertebrate and bird species. A primary motivation for creating this reserve was to preserve critical herring spawning habitat. Due to development in northern portions of the bay, and uncertainty regarding factors negatively affecting the Fidalgo Bay herring population, protection of herring spawning habitat is still a critical resource issue in Fidalgo Bay, as it is throughout marine nearshore areas of the Salish Sea.

Part 1—Environmental Setting— provides a broader overview of the physical and biological characteristics within or adjacent to the aquatic reserve. The major physical processes described are tidal regime, circulation, wave and current exposure, net shore drift, fresh water and sediment input. These processes — coupled with landforms and sediment types — provide the foundation and constraints for the biological community within and adjacent to the Fidalgo Bay aquatic reserve. A brief description of the primary habitat types, species and their distribution summarizes the ecological conditions. Understanding the processes and functions in Fidalgo Bay helps guide aquatic land management actions that influence the reserve and its associated ecological relationships.

Part 2—Current Environmental Conditions and Ecosystem Stressors— presents our collective knowledge of the current physical, biological and environmental conditions affecting the health of the aquatic reserve, with particular focus on the ecosystem stressors contributing to these conditions.

All references for the citations in Appendix A can be found in the Management Plan Section 7–References.

Part 1 – Environmental Setting

Physical Environment

Regional Physiography

Fidalgo Bay occupies an ancient delta of the Skagit River consisting of generally shallow mudflats that drop off steeply away from an arc that runs south and east from Cap Sante Head (City of Anacortes 2000). Spits are prominent landform features on both sides the bay. Extending out from the northeastern shore are Crandall Spit and the less pronounced Little Crandall Spit. Weaverling Spit sweeps out from the western shoreline trending out to the southeast about a third of the way across the bay. Just south of the spit, an old railroad bed consisting of a filled rip-rap causeway now supports the Tommy Thompson trail. The causeway extends eastward across tidelands spanning nearly half the bay, the other half consisting of a creosote-treated wooden trestle. This formidable structure bisects the bay at Weaverling Spit, constricting water and sediment movement in the southern portion of the bay. Extensive intertidal sand/mudflats occupy nearly all the tidal area south of the railroad trestle (Map C-6). The silty mudflats north of the trestle include some lower intertidal areas but are mostly subtidal with depths shallower than 12 feet below mean low lower water (MLLW).

The general bathymetry north of the bay consists of a fairly deep channel reaching depths greater than 10 fathoms (60 feet) within Guemes Channel and extending eastward to Hat Island, where it turns northward. The oil refinery loading docks located off March Point are constructed to reach these deeper waters and regular dredging maintains a minimum channel depth of approximately 40 feet in this area. A deep, circular hole lies between Cap Sante — the southeast point on Guemes Island — and Hat Island, with depths in excess of 40 fathoms (City of Anacortes 2000).

Across the northern portion of the bay, two navigation channels have been dredged providing medium draft boats clear passage to marinas and industrial properties along the eastern shoreline (City of Anacortes 2000). Along the northeastern shoreline of the bay about a quarter mile offshore, a natural channel about 15–20 feet deep (MLLW) continues south maintaining a narrow channel under the railroad trestle. Steadily shoaling south of the trestle, the channel diffuses into a fan-shaped, permanently flooded area of approximately 4–6 feet deep (MLLW). About a quarter of the way into the south bay, continued shoaling gives rise to extensive mudflats creating the dominant feature of the inner bay.

Due to its salinity profile, proximity to the ocean, and at least occasional freshwater runoff, Fidalgo Bay exhibits estuarine water regime characteristics (Dethier 1990). From May 2006 to May 2016, the Samish Indian Nation environmental staff regularly sampled at three water quality sites throughout the bay. The recorded salinities range between 23.3 parts per thousand (ppt.) and 35.59 ppt. with an average of 29.18 ppt. (T. Woodard, Samish DNR, personal communication, 2019). These data technically represent higher transitional salinities than a typical estuarine regime. However, geographic location, the morphological character of the bay, the biological assemblage and functions, and predominantly estuarine processes, sustain an estuarine water regime category (Dethier 1990).

Watershed-Drainage Basin Description

The south Fidalgo Bay drainage area flows primarily north into the bay and encompasses approximately 1,575 acres. The area is divided into two primary sub-basins with two additional sub-basins. The largest sub-basin is located west of Highway 20 and is primarily steep and forested, with small residential and commercial facilities in the vicinity of Highway 20 and the Highway 20 spur to

Anacortes. There are several crossings of the Highway 20 spur, all of which discharge into Fidalgo Bay almost immediately after crossing the road. The area east of Highway 20 also drains into Fidalgo Bay. This region encompasses a mix of commercial, residential, and forested uplands (some with conservation easements), and includes a portion of the Similk Beach golf course (now Swinomish Golf Links). (Anacortes S. March Pt. Annexation Comprehensive Drainage Study 1999).

Two smaller sub-basins are located north of Highway 20: One sub-basin drains westerly via ditches and culverts into an area at the southeastern side of the bay. This area is separated from the bay by a dike. The fourth sub-basin, on the east side of the bay, drains westerly from the ridge crest of the March Point Peninsula toward Fidalgo Bay.

Surface Water and Runoff

No major freshwater streams flow into the Fidalgo Bay Aquatic Reserve area. However, just south of Anacortes Marina, Ace of Hearts Creek flows down from Heart Lake and maintains minimal year round flow into the bay. Most freshwater input is limited to runoff into the bay (non-point sources), a few small intermittent creeks, and numerous outfalls. Surface water input at the south end of the bay has mostly been cut off by Highway 20. Runoff throughout the southwest basin is primarily collected in roadside ditches and conveyed toward the golf course, where it is pumped across Highway 20. The pump station, owned by Skagit County, consists of a pump house located between Swinomish Golf Links and Highway 20. The pump station is surrounded by ditches, which run adjacent to Highway 20, and a large pond that is incorporated into the golf course. According to information received from Skagit County, the runoff discharges through an 18-inch water main at up to 7,500 gallons per minute. The estimated drainage area contributing to the pump station is 536 acres. During extreme storm events, water that backs up behind the pumping facility will pass through a culvert beneath Highway 20 and discharge into Fidalgo Bay (City of Anacortes, South March Pt. Annexation Comprehensive Drainage Study 1999). Additionally, small visible channels can be seen in the southwestern end of the bay, and during high runoff periods in the rainy season, it appears that freshwater flows through these channels. At times in the winter, water in this portion of the bay freezes where the inflow occurs, demonstrating that it is freshwater inflow. (B. Cateret, Friends of Skagit Beaches, personal communication, 2019). In 2018, a roundabout was constructed at Sharpe's Corner along the southwest side of the bay. The project included use of best management practices, i.e., Compost Amended Vegetated Filter Strips (CAVFS). The project design exceeds the requirements of the Hydraulics Manual guidelines and the Highway Runoff Manual (HRM) to treat stormwater runoff. These Best Management Practices (BMPs) have the capacity to treat ~ 3.5 times more than the area required (Skagit County MRC Minutes, Meeting with WSDOT 1-11-18).

On the Shell Puget Sound Refinery property (directly east of the reserve), surface run-off from 558 acres of the refinery area is collected and directed to the refinery's wastewater treatment plant. In areas outside of the refinery's process units, run-off is collected through a network of ditches and culverts referred to as the 'clean water sewer' and directed to the stormwater pond (settling basin) to remove suspended solids, (N. Biletnikoff, Shell Oil, personal communication, 2019). Shell treats process water, domestic wastewater, and stormwater in primary and secondary systems consisting of two tanks which serve as both surge and overflow tanks. The system includes a three bay API oil/water separator, three dissolved air flotation units, a pretreatment bioreactor; a three-bay oxidation channel, two clarifiers, and an intermediary retention basin, a stormwater pond, a final holding pond, and a chlorination system. Treated process water, sanitary wastewater, stormwater, and ballast water from the refinery are treated, tested and then discharged through an outfall approximately one mile out into Guemes Channel (Outfall 001). The outfall is a 24-inch multi-port submerged diffuser located at a water depth of 42 feet MLLW. The remaining area draining into the

east side of the bay includes a few small intermittent streams which form during times of high precipitation, and small areas with limited surface run-off that drains into ditches along the West March's Point Road and discharges into the bay (City of Anacortes 2000).

The city of Anacortes, to the west, has three combined sewer overflows that discharge into Guemes Channel, to the north and west of the reserve. However, the stormwater outfall collected from city streets and parking lots drain untreated into the Fidalgo Bay (City of Anacortes 20xx). There are 24 city outfalls that drain directly into Fidalgo Bay in close proximity to the aquatic reserve area. The Samish Indian Nation DNR have sampled outfalls in Fidalgo Bay since 2005. At a few sites, where they had identified high fecal coliform counts related to a city outfall, they have worked with the city to investigate and resolve some of these issues. The city and the Samish Indian Nation will continue to collaborate with water quality sampling in the Fidalgo Bay watershed as well as other stormwater related projects. Other projects to improve stormwater treatment flowing into the bay include part of the Custom Plywood Mill cleanup project. Washington State Department of Ecology (Ecology) constructed a bio-swale and pocket estuary for stormwater flowing down from the area of 34th Street and possibly Fidalgo Bay Road above the area. During wet months the pocket estuary has standing water that varies with tidal influence but during the summer it is primarily dry (B. Carteret, Friends of Skagit Beaches, personal communication, 2019).

Groundwater

Information regarding groundwater monitoring wells installed near West March's Point Road by Cascade Drilling, Inc. states that groundwater was first encountered at a depth of approximately 15 feet below land surface (J. Murnane, Cascade Drilling, personal communication,1999). In this same vicinity, Shell Puget Sound Refinery has 128 groundwater wells on their property, some are regularly monitored and others intermittently monitored (20 percent have been decommissioned after post-closure). Groundwater depths on the west side of March Point vary between approximately 5 to 30 feet below the surface depending on the wetness of the season (Biletnikoff, Shell Oil, personal communication, 2019). Given suitable soil types, the groundwater surface in an unconfined aquifer will mimic local topography, and groundwater will flow toward topographic lows (DNR 1999), the direction of shallow groundwater flow is predominantly toward Fidalgo Bay. The ground water flow rate toward Fidalgo Bay is approximately 110 feet per year (Rhodes, personal communication). A portion of freshwater flow, originating from groundwater flows, still seeps directly into the bay, particularly in the south end of the bay.

Upland Surficial Geology

In general, the soils within the Fidalgo Bay drainage area consist of moderately deep, poorly to moderately drained soils on terraces and hills. The soil groups include approximately 44 percent Bow soils, 21 percent Coveland soils, and 20 percent Swinomish soils. The remaining 15 percent are components of minor extent.

Bow soils overlay glacial remnant terraces, and are described as very deep and somewhat poorly drained. The surface layer is gravelly loam over very gravelly sandy loam about 14 inches thick. The upper layer of the subsoil is gravelly loam about 8 inches thick. The lower part of the subsoil, to a depth of 60 inches or more, is clay loam over silty clay. Coveland soils are located on swales on glaciated hills and are described as very deep and somewhat poorly drained. The subsoil and substratum to a depth of 60 inches or more are silty clay.

Swinomish soils are located on glaciated hills. The soils are characterized as moderately deep and moderately well drained. The surface layer and upper part of the subsoil are gravelly loam about 20

inches thick. The lower part of the subsoil and the substratum are very gravelly sandy loam about 11 inches thick over dense glacial till. Depth to dense glacial till ranges from 25 to 40 inches (U.S. Department of Agriculture Soil Conservation Service 1989). There are a few areas of exposed bedrock (sedimentary rocks including sandstone and breccias), along the south and western sides of the bay.

Intertidal and Subtidal Substrate

Intertidal substrates within Fidalgo Bay include mud, sand, and gravel/cobble sediments, as well as, limited areas of natural bedrock and artificial hard substrates such as riprap, concrete, steel, and creosote wood pilings. Along the south fringe of the bay, associated with the rim of salt marsh plants, the substrate consists of sand, silt and clay mixed with decomposed organic matter. It includes peat deposits and locally inter-bedded layers of volcanic material (Pessl et al. 1989). The inner bay encompasses large tide flats of mixed fine clays, silts and sands that are predominant within the lower intertidal zone—extending from approximately 2 feet above MLLW to approximately 4.0 feet below. Subtidal sediments include mud bottoms with varying amounts of sand, gravel or cobble substrates, as well as hard bottom areas—both natural and human-derived (City of Anacortes 1999).

Mixed sand and gravel substrates dominate the upper intertidal shoreline along both sides of the bay. The western shore has a few areas where there is exposed bedrock, but surficial unconsolidated sediments are dominant and vary between 0–3 meters deep (Pessl et al. 1989). Along the eastern shore of the bay including Crandall and little Crandall spits to just south of the trestle, a narrow patchy band of pea gravel and coarse sand exists in the upper intertidal zone. These substrates are well suited for forage fish spawning and have been documented as regular surf smelt spawning areas. A few zones of predominantly "fluffy sands" also are utilized as sand lance spawning substrate (D. Penttila, Salish Sea Biological, personal communication, 2019).

Additionally, DNR's 1996 Intertidal Habitat Inventory includes a classification of intertidal substrate types for Fidalgo Bay (DNR 1996). However, these polygon delineations do not depict finer scale variations in substrate composition, such as upper intertidal mixed sand and pea gravel necessary for forage fish spawning habitat.

Shoreline Characteristics

The majority of the shoreline in Fidalgo Bay has been extensively modified and armored. Shoreline filling and armoring, such as "riprap" and concrete bulkheads, dominate the eastern and western shorelines in the bay. Of the 6 linear shoreline miles in or directly adjacent to the Reserve, 4 miles have been hardened or modified. Williams et al. (2003), report that most of the shoreline has been filled and approximately 73.8 percent of the shoreline in the greater Fidalgo Bay area has been armored. This includes the highly developed northwest shoreline from inside Cap Sante Head, south to slightly north of Weaverling Spit. Beach restoration projects improved more than 1,600 feet of shoreline adjacent to the Samish RV Park and Ecology clean-up sites, (the old Scott Paper Mill and the Custom Plywood Mill site), also had beach armoring removal and beach restorations, improving the characteristics of this section of shoreline. Less armoring and fill have taken place in the rest of the bay, however the percent of shoreline armored is greater than 60 percent (Williams et al. 2003).

The backshore areas and a considerable amount of the adjacent upland surrounding the bay is cut off by shoreline armoring, which prevents the natural sediment replenishment of the beaches. Also, associated with shoreline development and armoring is the removal of riparian vegetation. In the area previously mentioned on the northwest side of the bay and along the roadsides, especially March's Point Rd, most of trees and woody shoreline vegetation has been denuded. Some bluffs of

unconsolidated materials are located just north of Weaverling Spit, however, erosion of these bluffs and the sediment influx into the bay is practically eliminated by riprap or other armoring.

Physical Oceanographic Processes

Tides

Tides within the region and bay are a mixed semi-diurnal tidal cycle, with two lows and two highs of different sizes each day, and an average range of 1.5 meters between low and highs. The bay experiences moderate tidal currents with various wave regimes (National Ocean Survey Tide Tables 1980). At Anacortes, the mean tide range, defined as the average difference in height between Mean High Water (MHW) and Mean Low Water (MLW), is approximately 5 feet (City of Anacortes 1999). The diurnal tide range, defined as, the average difference in height between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW) is 8.5 feet. Each day 50 to 60 percent of the water in Fidalgo Bay is flushed out and refilled by tidal currents (Antrim 2005). Flood tide currents flow northeast from Guemes Channel, then south into Fidalgo Bay and reverse on the ebb tide. Observations of the subject property during high tide conditions revealed that the entire subject property is inundated with water, with the tops of several eelgrass patches exposed. Observations were subsequently made during a minus low tide condition approximately 6.5 hours later, revealing that approximately two thirds of the area south of the trestle is exposed tidal flat (Antrim 2005).

Wave Energy

Energy classifications as defined by Bailey et al. (1993) describe the relative degree of physical energy from waves and currents. These energy designations are applied to broad areas and describe landscape-level characterization of intertidal energy.

Fidalgo Bay fetch distances are generally short for westerly, easterly, and southerly winds. The strongest wind and wave energy originates from the northern part of Fidalgo Bay and travels most strongly toward March Point. The waves dissipate as they travel along the eastern shore of the aquatic reserve. Smaller waves generated from north Fidalgo Bay head directly south and are mostly deflected by Weaverling Spit. This northern portion of the bay is characterized as maintaining a "partly enclosed" energy level (Bailey et al. 1993). This classification refers to bays partially enclosed by headlands, bars, spits, or artificial obstructions reducing circulation. Wave action occasionally is strong enough to maintain a mixed sand/gravel intertidal substrate that is used for forage fish spawning. Crandall Spit and the railroad trestle also deflect and dissipate the wave energy from heading farther into the south end of the bay. Since this southern portion of the bay is largely enclosed, it has been classified at the lowest wave energy level as a "lagoon", receiving little wave or current energy.

Water Currents

Due to the shallow depth of the bay and relatively large tidal range, tidal currents dominate the movement of water into and out of Fidalgo Bay (City of Anacortes 1999). These currents are affected to some extent by winds. Freshwater within the system also slightly affects the tidal circulation. As freshwater enters nearshore areas, it begins moving seaward over several tidal cycles. In return, the more saline waters present at depth are drawn landward. Within the bay there is little mixing between the east and west side of the bay. Through the Olympia oyster restoration project, recent years of data with Olympia oyster natural recruitment in Fidalgo Bay, reveal largely north–south flowing currents during the summer on each side of the bay (Eric Grossman, USGS, personal communication, 2018).

Water current meter records available for Guemes Channel and Fidalgo Bay indicate that the apparent net flow within Guemes Channel is westward into Rosario Strait at all depths measured. Typical net flow velocities range from approximately 5 to 30 centimeters per second (0.1–0.6 knots per second). The deeper ocean water entering into the Fidalgo Bay region is most likely from Haro Strait, which then returns southward either via Rosario Strait. Insufficient measurements are reported from within Fidalgo Bay to assess either the net circulation or tidal current strengths. However, drogue (apparatus used for current analysis) trajectories have shown movement of water during ebb tide conditions from the March Point piers almost directly northwestward toward Cap Sante. Drogue and drift stick observations available within the bay are of such short duration and areal extent, that they do not contribute greatly to an understanding of tidal circulation patterns within the bay (City of Anacortes 1999). In general, due to the bay's shallow depths, water entering and exiting the bay first follows or is drawn to the deeper channels. Once filled, and during slack tides, surface water movement is primarily wind driven.

North of the subject area, visual observations, plus drift stick and drogue trajectories performed in previous studies, revealed that generally strong flood tides pass through Guemes Channel and begin to spread out after passing Cap Sante. Those headed east split as they reach Hat Island, heading either north or southwest into Padilla Bay, and deeper waters stay within the deep channel headed north. After passing Cap Sante, a portion of the surface flow rotates southward into Fidalgo Bay, and a large clockwise rotating eddy is reportedly formed to the east and south of Cap Sante during flood tides, causing a northward-directed current along its eastern face (City of Anacortes 1999). Ebb currents that leave Fidalgo and Padilla Bays converge with currents headed south from Samish Bay, merging west of Hat Island. A convergence zone where surface debris collects is often located south to southwest of Hat Island during ebb tides. Due to the water leaving Fidalgo Bay, during ebb tides a small counterclockwise eddy likely exists just north of Cap Sante. During both strong flood and ebb currents, back eddies along both shorelines have been noted, especially shoreward of piers (City of Anacortes 1999).

Net shore-Drift

Net shore-drift is the long-term, net effect of shore drift occurring over a period of time along a particular coastal sector, also referred to a drift cell (Jacobsen and Schwartz 1981). A drift cell is defined as consisting of three components: a site that serves as the sediment source and origin of a drift cell; a zone of transport, where wave energy moves drift material alongshore; and an area of deposition that is the terminus of a drift cell. Deposition of sediment occurs where energy is no longer sufficient to transport the sediment in the drift cell (MacLennan 2010). Coastal Geologic Services mapped drift cells and analyzed current net-shore drift patterns in the Fidalgo Bay area in 2007 (see Appendix C, Map C–7).

A drift cell occurs in the northwest sector of the bay, just south of the marinas, with net drift southward to the tip of Weaverling Spit. The shoreline in this sector was completely modified and therefore largely eliminates upland sediment input to the spit. As a result, scouring has taken place along the northern base of the spit due to the limited sediment sources and increased energy down drift from the shoreline armoring (Aundrea McBride, *pers. comm*. 2007). Since 2014, three phases of beach restoration covering approximately1,600 feet of shoreline on the northwest side of Weaverling Spit have restored some of the natural dynamics of this drift cell. The beach face was transfigured to accommodate a soft-armored backshore area with a significant quantity of sediment added to elevate the beach profile. Logs are systematically placed and anchored cross-shore in the mid to upper intertidal zone to moderate sediment movement down drift. Just north of the reserve boundary, up-

current in this same drift sector, wood waste and sediment clean-up of the Custom Plywood Mill have added to improve overall habitat and sediment quality in this portion of the bay.

On the east side of Fidalgo Bay, nearshore drift from the northern end of March Point is predominantly westward, (north of the reserve). The westward littoral drift sector forms Crandall Spit at the northeast corner of the reserve. Areas of deposition include the beaches at Crandall Spit, however analysis by Johannessen (2007) shows this drift sector is sediment starved by evidence of significant loss in area to Crandall Spit. Since, there are few remaining natural sources for shoreline sediment along this drift sector, this appears to be affecting Little Crandall Spit as well. A northerly drift sector lies north of Little Crandall Spit along a lightly modified shoreline.

Within the south bay area, transport processes move lightly to the north along the eastern shoreline but are disrupted by widespread shoreline armoring and the railroad trestle. Originally constructed in 1891, the railroad trestle spanned the bay entirely on pilings. Sometime during the early to middle part of the last century the western portion of the trestle was modified with extensive fill and riprap built up around the pilings. This extensive modification extends along the south side of Weaverling Spit and continues more than half way across the bay. Although the remaining portion of the trestle is built on pilings that allow water flow, the entire structure has seriously hindered the natural flow patterns and continues to impede sediment distribution for the bay. The consequent and continual decrease in the tidal prism, with no appreciable drift at the head of the bay, has led to significant sediment deposition in the south bay (A. McBride, Coastal Geologic Services, personal communication, 2007).

Biological Environment

Habitat Resources

For the purposes of this report, we are specifically focusing on the ecosystem continuum of nearshore habitats adjacent to or within the boundaries of the aquatic reserve. The processes presented in the previous sections—such as tidal regime, circulation, wave and current exposure, net shore drift, fresh water and sediment input, coupled with landforms, sediment types, and anthropogenic alterations—provide the foundation and constraints for the biological community within and adjacent to the reserve. Nearshore areas serving key habitat functions within or adjacent to the bay range from the deep-water mud and sand bottoms of outer Fidalgo Bay, to the emergent salt marshes along the southern fringe of the inner bay. Most of the adjoining backshore areas and uplands have been cut off from the bay by roads, shoreline armoring or other development.

Habitat Areas

Several distinct intertidal and shallow subtidal habitat areas exist within the bay. The upper intertidal areas intermittently support a fringe of emergent marsh vegetation on mixed fine substrate. Below this fringing marsh, in the southern end of the bay, is a broad crescent-shaped area of siltier tidal flats dissected by small tidal sloughs and with pronounced islets of *Salicornia.* At slightly lower elevations and farther out in the flats are isolated pillar-like hummocks with sparse remnants of sedge and other salt marsh vegetation on top. Extensive tidal flats of fine unconsolidated sand, silt and clays are inundated by the highest tides and form the bulk of the intertidal area in the south bay and the majority of the intertidal area in the reserve. This extensive area provides foraging and resting grounds for resident and migratory shorebirds, waterfowl, and fish. Mudflats in shallow embayments are also particularly critical as nursery and foraging habitat for juvenile fishes and flatfish. These low energy tidal flats support productive micro and macro-algal species and provide prime habitat for

juvenile salmonid prey resources like harpacticoids, copepods, and amphipods (*Corophium* spp.) (Healy 1979, Healy 1980, Simenstad et al. 1980).

Other intertidal habitat areas within the bay include mixed fine, gravel/cobble beaches, as well as limited areas of natural bedrock and artificial hard substrates such as pilings and riprap. Salmonids, specifically steelhead, sea-run cutthroat and anadromous Bull Trout are likely to utilize the low energy mixed gravel and cobble beaches of the bay for foraging and shelter (Healy 1982). In addition, areas of sand to mud bottom within the lower intertidal zone (from approximately +2 feet above MLLW to approximately -4.0 feet below MLLW) support patchy to lush growths of eelgrass (*Zostera marina).* Often a variety of macroalgae and epiphytes grow in association with the eelgrass. Other areas in the same depth range, but with scattered gravel/cobble substrates, support dense growths of macroalgae that maintain a variety of habitat functions. Macroalgae beds, dominated by soft brown kelp species often grow intermixed with the eelgrass. Other subtidal habitats include mud bottoms with varying amounts of sand and gravel, and some hard bottom areas—both natural and human-derived (City of Anacortes 2000).

Aquatic Vegetation

Eelgrass

Eelgrass beds of varying size and densities within the larger Fidalgo Bay–Guemes Channel–Padilla Bay area provide unique expanses of vegetated habitat with connectivity covering about 7,000 acres. This extensive eelgrass is the largest areal coverage of this habitat type in the southern Salish Sea.

Eelgrass is the primary ecologically important habitat in the Fidalgo Bay Aquatic Reserve, supporting multiple ecological functions in the bay, including:

- Providing substrate for epiphytic algae, epifauna, and substrate structure for spawning of Pacific herring,
- Providing rearing habitat for juvenile salmon, crab, other fishes, by providing shelter and an abundance of prey species,
- Altering the physical environment by modifying current and wave energy,
- Providing shade and thus cooler water and higher dissolved oxygen during summer low tides,
- Contributing to food webs—food for herbivores and detritivores via primary production,
- Providing a high capacity form of carbon sequestration, and
- Buffering the local waters by sustaining lower levels of pH (M. Horwith, Washington DNR, personal communication, 2019).

Several distinct intertidal and shallow subtidal areas within the bay support lush growths of eelgrass (*Zostera marina*) which is a key habitat component of the bay. Eelgrass historically covered a large portion of the shallow subtidal areas in Fidalgo Bay, at varying densities. The broad mudflats and other areas of the bay with better circulation appear to have sustained more or less continuous eelgrass beds (Figure A–1). The majority of the bay, however, now maintains patchy eelgrass beds with relatively low stem densities compared to the densities and expanses found in nearby Padilla Bay. Often a variety of macroalgae grow in close association with the eelgrass.

Fidalgo Bay eelgrass is critical spawning habitat for a declining northern Puget Sound herring stock. Historically, herring spawn was found wherever eelgrass existed in Fidalgo Bay, even in areas where eelgrass was only sparsely distributed. Eelgrass is found at depths in the bay from +1 feet MMLW to -12 feet MLLW (Pentec 1994).

Based on long-term herring spawn survey data, significant loss of eelgrass and consequently herring spawning habitat is known to have occurred in Fidalgo Bay. Historic losses can be attributed to log storage practices, dredging, development and filling of the shoreline and intertidal areas particularly in the northeastern portions of the bay where there are several large marinas and concentrated commercial activity. Additionally, less extensive areas of eelgrass and macroalgae have been diminished by shading from overwater structures, such as the March Point piers and the railroad trestle. DNR Submerged Aquatic Vegetation Program (SVMP) has been monitoring eelgrass in the bay from 2004 to 2018. Bart Christiaen, from the SVMP staff conducted a recent trend analysis of Fidalgo Bay eelgrass monitoring data over the past decade. "DNR surveyed Fidalgo Bay seven times between 2009 and 2018. During this period, there was on average 76 (± 5) ha of eelgrass within the boundaries of the aquatic reserve. The majority of eelgrass occurred north of the railroad trestle. Most eelgrass was found between -0.5 and -2 meters depth at MLLW. Eelgrass had a more limited depth distribution in the southern part of the reserve. North of the railroad trestle, eelgrass was relatively stable over time. South of the trestle, eelgrass beds experienced a significant decline between 2009 and 2018. The decline was most pronounced at the western side of the Bay." (B. Christiaen, DNR SVMP, 2019).

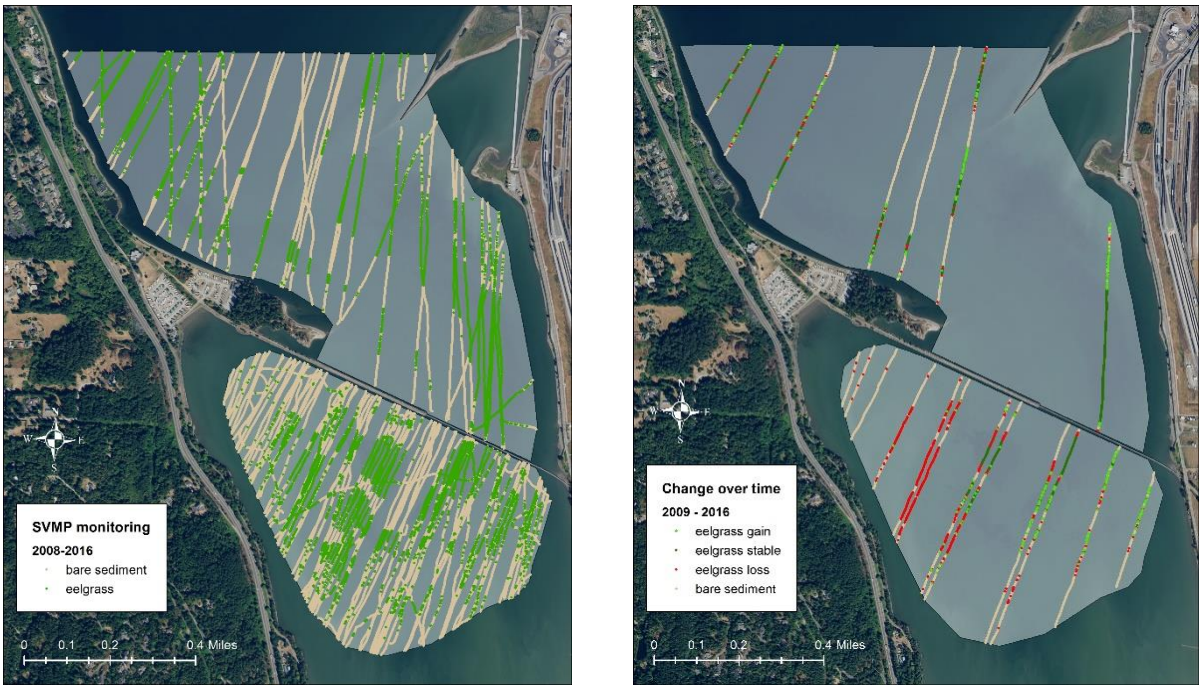

Figure A–1. Comparison of SVMP eelgrass transects clipped to the reserve boundary. Left photo shows total presence/absence for all transect locations over 7 total sample years; Right photo shows transect gains, losses and stable locations at repeat transects taken in 2009 and 2016.

Because of these significant losses in both depth and spatial distribution, and due to uncertainty regarding factors limiting herring populations in Fidalgo Bay and elsewhere, WDFW and DNR consider protecting eelgrass and other herring spawning habitat to be a critical resource issue statewide.

Macroalgae

Intertidal and subtidal algae provide habitat for countless invertebrates and fish. Macroalgae (seaweed) provides many similar ecological functions as eelgrass beds —such as creating more habitat structure, and contributing to the higher productivity of the ecosystem. The macroalgae assemblage present in the reserve area is composed of many species adapted to a variety of habitat types. Overall, species distribution and coverage provides a broader distribution both vertically and laterally than eelgrass.

Within the upper intertidal areas of the bay, on hard substrates starting below approximately 6 feet MLLW, areas of dense growths of seaweeds are prevalent and are dominated by the perennial rockweed, *Fucus gardneri, Porphyra* spp., *Mastocarpus* spp. and ulvoids. The predominant seaweed assemblage in both intertidal and subtidal areas of unconsolidated mixed fine sediment are green algae, or ulvoids such as *Ulva*, *Ulvella* and *Enteromorpha*. Primarily in summer, these species are commonly present throughout intertidal areas often extending below MLLW and into eelgrass beds. These species also provide a variety of functions including supporting microhabitats for juvenile crab and other invertebrates and releasing nutrients back to the marine environment. However, at times high biomass blooms of ulvoids can present a nuisance by physically smothering burrowing invertebrates and reducing physical access and prey availability. A variety of red algae species, such as *Gracilaria pacifica,* and *Graciliariopsis sjoestedii are f*requently found intermixed with and adjacent to eelgrass beds which also provide a substrate for herring spawn deposition.

Other lower intertidal and shallow subtidal areas with scattered hard substrates support growths of large-bladed laminarian kelps, with the most common species being *Saccharina lattisima* (*Laminaria saccharina), Costaria costata* and the brown alga *Desmerestia* spp. Juvenile fishes including salmon, as well as Dungeness crab utilize the shallow subtidal macroalgae beds, for nursery, refuge and foraging areas.

Salt Marsh

Alt1hough there are no large expanses of salt marsh habitat in the bay, fringing and patchy salt marsh areas provide important feeding and rearing habitat for many species of fish, shorebirds, invertebrates and other wildlife. Small patches of salt marsh rim the head of the bay and are dispersed along the shoreline on both sides of the inner bay including a pocket in the south corner of Weaverling Spit. These marsh areas are dominated by pickleweed (*Salicornia virginica*) and saltgrass (*Distichilus spicata*), as well as an occasional show of saltwort (*Glaux maritima*) and sea-side arrow grass (*Triglochin maritimum*). Crandall and Little Crandall Spits also have small areas of upper intertidal salt marsh. A rim persists beneath the beach berm on both sides of Crandall Spit and in a small "embayment" encompassed by the spit.

These habitat areas are important to estuarine ecosystems like Fidalgo Bay (reference). The salt marsh bordering the southern boundary of the bay provides the necessary transition zone between freshwater and saltwater. Likewise, this area furnishes connectivity to the terrestrial system adjacent to the reserve. This habitat also serves the functions of providing an impediment to erosion, a source of tidally exported detritus and nutrients throughout the bay, and shelter as well as, foraging ground for marine invertebrates, birds and juvenile salmon.

Berm Vegetation

Berm vegetation is interspersed throughout the bay on both Crandall and Weaverling Spits and in narrow fringes or small patches in the inner bay. Berm areas are beyond the reach of the highest tides, and are infrequently inundated by salt water—in the "spray zone". Since these locales are

subject to salt spray and seldom get inundated, a different plant community subsists in this zone. The plant species identified in the bay are dune grass (*Leymus mollis*), gumweed (*Grindellia integrifolia*), Yarrow (*Achillea millefolium*), and Ambrosia (*Ambrosia artemisiifolia)*. The substrate is usually a mixture of sand and smaller gravel, with drift logs often present.

Freshwater Wetland

A few brackish and freshwater wetland areas have been identified in Fidalgo Bay and adjacent to the Aquatic Reserve. At the southeastern corner of the bay is a small seep wetland that is dominated by cattails (*Typha latifolia*). It is bisected by March's Point Road and is also associated with stormwater runoff from the north side of Highway 20. This wetland is separated from the bay by a dike. As with many wetlands, this area functions as a water retention and filtration buffer, potentially improving water quality. On the bay side of the wetland, along the inner edge of the dike is a narrow band of obligate salt marsh plants indicating saltwater seepage through the dike into the outer edge of the wetland.

Fish and Wildlife

Most of the aquatic lands within the aquatic reserve area support a wide range of migratory and resident birds, fish and marine invertebrates. The extensive eelgrass beds are used annually in the late winter, by a small, and in recent years, barely present herring spawning stock. Additionally, Fidalgo Bay is identified as a juvenile and larval rearing ground for Dungeness crab, salmonids, herring and other marine fish. A large number of great blue herons feed in the bay year-round and substantial numbers of migratory birds are found in the bay in the winter. Extensive mudflats and fringing salt marsh attract shorebirds and juvenile fishes while the large, intact sand spits — Crandall and Weaverling Spits — are important for forage fish spawning and marine bird refuge. The bay supports habitats and species similar to two other local bays — Samish Bay and Padilla Bay. Padilla Bay is a National Estuarine Research Reserve jointly managed by the National Oceanic and Atmospheric Administration (NOAA) and the State Department of Ecology.

In neighboring Padilla Bay and the nearby waters, at least 57 species of fish have been identified (US Dept. of Commerce 1980). Many of these species are likely to use nearby Fidalgo Bay with its similar habitat. In the last several years, the Samish Indian Nation has identified 30 species of fish in just two years of beach seining surveys. A partial list of fish species observed in Fidalgo Bay can be found in Appendix B, Table B-2.

Salmon

Limited observations have been made on salmonid distribution and abundance within the study area. Based on studies in Skagit Bay, the Swinomish Channel, and in Guemes Channel, juvenile salmon are present during the major spring migrations out of the Skagit and Samish Rivers (City of Anacortes 1999). Although the number of salmonids using Fidalgo Bay has not been recently quantified, in April 2004, Beamer et al. captured 0+ chum and pink salmon averaging 1,250 juvenile salmon per hectare (Beamer et al. 2006). The Samish DNR beach seine surveys between 2015–2017 also found juvenile chum and pink salmon to be a common catch and documented the brief presence of Chinook and coho salmon in the bay (M. Castle, Samish Indian Nation, personal communication, 2019).The eelgrass beds provide shelter and an abundant food supply for smaller juvenile salmon. Juvenile salmon also utilize the shallow subtidal macroalgae beds and the low energy tidal flats that are well known foraging areas for amphipods, such as *Corophium* spp. Even though the broader mudflats without eelgrass may support an abundant prey base, they are less used by juvenile salmon since they lack cover for refuge.

Other species of salmonids, such as sea-run cutthroat, and anadromous Bull Trout may utilize the low energy mixed gravel and cobble beaches in the area for foraging and shelter. Although there is no published information on the occurrence of Bull Trout in Fidalgo Bay, the area is known to contain essential features of designated federal critical habitat, such as prey species like forage fish in nearshore areas, a primary constituent element of critical habitat (Federal Register 2005, 2016).

Forage fish

Forage fish are a vital link in the food chain and constitute a major portion of the diets of salmon, seabirds, marine mammals, and other fish. Three important species of forage fish utilize intertidal and shallow subtidal areas in Fidalgo Bay for spawning habitat.

Pacific herring (*Clupea pallasi*), is an important baitfish and commercial fish in the northern Puget Sound Region. Adult herring (pre-spawners) are reported to congregate in the area to the east of Guemes and Hat Islands before spawning. Small groups reportedly move south into Fidalgo Bay intermittently as each group matures. Historically, spawning in Fidalgo Bay was more or less continuous from early February into April but deposition of spawn has been consistently reported as "very light" to "trace" in the WDFW rating system.

Herring deposit their eggs indiscriminately on eelgrass or macroalgae (particularly, *Gracilaria* spp.). Herring spawn has been found wherever eelgrass exists in Fidalgo Bay, and even in areas where eelgrass is sparsely distributed. Appendix C, Map C–11, shows the areas of identified herring spawning beds and trends for the last decade in Fidalgo Bay.

Herring roe on eelgrass provides critical seasonal feeding opportunities for waterfowl, fish and invertebrate species. Herring eggs hatch approximately 2 weeks following deposition, and many larvae appear to remain in the bay for several months. The back or southern portion of the bay contains large numbers of herring larvae around the end of March (D. Penttila, WDFW, personal communication 2006). Herring larvae provide nutrients to out-migrating salmon smolt and other fish species that use these nearshore waters for nursery and feeding grounds. After their first summer, it is uncertain where the maturing herring go to complete their growth and maturation before returning to spawn 3 to 4 years later.

Surf smelt (*Hypomesus pretiosus*) also are an important forage fish in the Salish Sea. During the winter months, surf smelt, possibly from the Fidalgo Bay spawning populations, are the subject of a vigorous recreational jig fishery in the La Conner area, and along the March Point shoreline. In the summer, there is bustling recreational dip net activity for surf smelt along the western shore, slightly north of the reserve boundary.

Surf smelt spawn at middle to upper intertidal elevations (in Fidalgo Bay area from + 5 feet MLLW to +9 feet MHHW) on pea gravel and coarse sandy beaches. Spawning beaches are ubiquitous in the bay north of the trestle with spawning beaches documented south of the trestle as well, (see Appendix C, Map C–12). Spawning tends to occur year round in Fidalgo Bay. Trained citizen scientists have conducted forage fish beach spawning surveys in the bay since 2012. Presently, approximately 4.3 lineal miles of surf smelt spawning beach has been identified within the bay. In spite of extensive armoring, the remaining narrow, patchy strips of suitable substrate at the base of armored shoreline are still utilized for spawning. This habitat and substrate area is very vulnerable to disturbance and continued loss, for lack of sediment replenishment. Appendix C, Map C–12 illustrates the locations of documented surf smelt spawning beaches in Fidalgo Bay. Little is known of the larval and post-larval life history of surf smelt in the area.

Pacific sand lance (*Ammodytes personatus*) have been found to spawn in the upper intertidal area on several beaches throughout the bay. Sand lance have a limited spawning window in the greater Puget Sound area, generally from early November through mid-February with eggs present into March. Sand lance tend to utilize similar substrate as surf smelt, preferring pea gravel, shell hash, and sand at slightly lower tidal elevations. In addition, sand lance demonstrate a preference for well-aerated soft sand; spawning in the bay is reported primarily in this soft sand. Sand lance spawn is documented in some of the same areas as surf smelt spawning. Spawning beaches have been identified at the northeast tip of March Point, south of Crandall Spit, on the eastern end of Weaverling Spit, and in mid reach on the eastern side of the reserve, north of the trestle. (WDFW 2005, Fidalgo Bay CSC 2018).

Other Marine Fish

WDFW has not focused any specific surveys on marine fishes in Fidalgo Bay. However, the mudflats and shallow embayments throughout the bay are considered the most important habitat areas for flatfish species. Many flatfish —such as starry flounder, English sole, speckled sanddab and sand sole, show a distinct preference for shallow waters in the bay and may remain near the shore even as adults. Flatfish spawn is found in small quantities within the bay. The two flatfish in the area of greatest commercial importance are starry flounder (*Platichthys stellatus*), and English sole (*Pleuronectes vetulus*). For a list of fish observed in the bay, see Appendix B, Table B-2.

Marine Invertebrates

Many species of marine worms, snails, clams, crabs, small crustaceans, and other invertebrates provide vital links in the Fidalgo Bay food chain by providing food for local populations of birds, fish and mammals. Systematic data collection on intertidal invertebrates is limited for the Fidalgo Bay Aquatic Reserve. Tribal shellfish surveys, in addition to three years of intertidal biota monitoring by the Fidalgo Bay Citizen Stewardship Committee from 2016–2018, were conducted at four locations on the west side of the bay. These data are contributing up-to-date baseline information for plant and animal presence and distribution. Eventually, the data may provide the opportunity to look at trends and analyze different beach treatments on this side of the bay. For a partial list of marine invertebrates found in the bay, see Appendix B, Table B-4.

Shellfish

No comprehensive surveys of Fidalgo Bay have been conducted for hard-shelled clams. However, several species of clams — including the butter clam (*Saxidomus gigantea*), native littleneck (*Leukoma staminea*), Japanese littleneck (*Venerupis philippinarum*), horse and gaper clam (*Tresus* spp.), and the cockle (*Clinocardium nuttallii*) — are common on Weaverling Spit beaches. Samish Indian Nation in conjunction with students from the Anacortes High School Green Program conduct shellfish surveys in the summer on the north side of Weaverling Spit. Surveys are carried out at several tidal elevations during a minus tide in May. Data from these surveys also notes other species including, Eastern soft-shell clams (*Mya arenaria*), *Macoma* species, and the non-native purple varnish clam (*Nuttalia obscurata*). However, an important finding from the tribal clam surveys shows primarily one size class and low populations of butter clams. For this reason, harvest of butter clams is closed on Samish owned beaches in Fidalgo Bay until the population recovers (T. Woodard, Samish DNR, personal communication, 2019). Hard-shelled clams also are found on other beaches north of the trestle in lower intertidal areas containing an appreciable amount of gravel mixed with sand, silt and mud. Shellfish harvest is popular and occurs on several beaches in the bay with a WDFW shellfish license.

During the 1950s, Fidalgo Bay supported extensive oyster culture operations until they died out or moved in the 1960s to more favorable grounds to the north in Samish Bay. Limited numbers of Pacific oysters were consistently found in Fidalgo Bay. However, a large recruitment of oysters occurred in the early 1990s and was observed again in 2005. Possible sources for these events appear to be natural recruitment from Samish Bay or from the modest population of Pacific oysters residing in Fidalgo Bay (Dinnel et al. 2005). These events are episodic and the persisting population of Pacific oysters continues to be relatively small.

The Olympia oyster (*Ostrea lurida)* is the native oyster once found at scattered sites throughout Puget Sound including Fidalgo Bay. The bay has favorable habitat conditions and unlike other bays in the area is free from a significant population of Pacific oysters, and the associated, devastating Japanese oyster drills (Dinnell et al. 2005). In 2002, Fidalgo Bay was selected as a planting site to restore a population of Olympia oysters in the region. Olympia oyster seed has been planted and monitored in the bay since 2002 and subsequently in 2003, 2004, and 2006.

More deployments of oyster spat have continued over the years along with non-seedbearing oyster shell to increase habitat availability and help build oyster beds (Dinnel et al. 2018). Over the years, the population of oysters has increased with large fluctuations in natural recruitment. Annual recruitment of invertebrate broadcast spawner species often tends to be highly variable, and Olympia oysters are no exception (Dinnel et al. 2018). Through this project, "Spatial patterns of settlement in Fidalgo Bay have been nicely defined. Sampling from 2008 to 2018 strongly indicate that most larvae are retained inside the bay and that settlement has almost exclusively been limited to the east side of the bay, with the causeway area one of the focal points. Few oyster larvae are making their way to the west side of the bay due to largely north-south flowing currents during the summer on each side of the bay with little mixing between them, (Dinnel et al. 2018; E. Grossman, USGS, personal communication, 2018). As of 2018, the number of oysters has gradually grown to approximately 2.9 million in the bay. Other encouraging findings include natural recruitment of native oysters in several sloughs in the south bay (Dinnel et al. 2018).

The geoduck *(Panopea abrupta*) is likely to be present in the deeper regions of the bay (Munce et al. 2000). WDFW has not conducted any geoduck surveys in the area. Provided with the appropriate substrate types, mainly sand and silts, geoducks are generally found from the lower intertidal zone to at least 360 feet in depth. The presence of geoduck is likely within the bay in less disturbed subtidal areas with sand to silt sediment.

Dungeness crab (*Metacarcinus magister*) are widespread throughout the Fidalgo Bay area, and are expected to use all habitats below a depth of approximately 2 feet above MLLW, except perhaps for bedrock outcrops and other hard bottom areas where the red rock crab (*Cancer productus*) is expected to be more abundant (City of Anacortes 1999). Eelgrass beds, macroalgal beds, and areas with an abundance of broken shell material provide preferred areas for juvenile crabs.

There are no regularly surveyed WDFW index stations for Dungeness crabs in the Fidalgo Bay area. Crab fishing occurs in Fidalgo Bay by State-regulated recreational and commercial fishers, as well as Tribal recreational and Treaty Commercial fishers. The Northwest Straits Foundation recently contracted with Natural Resource Consultants to complete a large-scale derelict crab fishing gear recovery program in the deeper water areas north of the bay.

Over-wintering ovigerous (bearing or carrying eggs) female Dungeness crabs are known to occur in significant numbers in areas nearby Fidalgo Bay—like the shallow embayments around Guemes Island (see Armstrong et al. 1987). Female crabs spend most of a 3-to 4-month period between

November and April buried in the sediment in eelgrass from 1.6–13.1 feet deep (0.5–4 m.) MLLW. The population of ovigerous crabs in 1985/86 was estimated to be 60,000, with about 25 percent found in nearby Ship Harbor. Although very few of these crabs have been documented in other regional bays, the unique importance of this sensitive life stage and proximity to Fidalgo Bay reinforces the importance of minimizing negative impacts to these habitats. Armstrong et al. (1986) found that young-of-the-year Dungeness crabs use vegetated portions of Fidalgo Bay as rearing habitat before moving to deeper waters (Armstrong et al. 1987).

Birds

Fidalgo Bay is part of a larger area that is recognized as one of the most important waterfowl wintering spots along the Pacific flyway, providing critical habitat connectivity for migratory and overwintering ducks and waterfowl. The main species of birds that use Fidalgo Bay's rich and productive habitat include Brant, cormorants, peregrine falcons, great blue herons, loons, and bald eagles, along with many gulls, shorebirds and dabbling and diving ducks (Antrim et al. 2000). Approximately 240 birds have been identified in the broader Padilla, Samish, and Fidalgo Bay area (Padilla Bay NERR 2008). Many of these birds are not marine and shoreline dependent and not all the marine dependent birds use Fidalgo Bay habitat areas. None-the-less, numerous bird species associated with marine and shoreline habitat are observed in Fidalgo Bay. The highest occurrences and diversity of bird species are found during the winter months and occur at much lower levels or are absent the rest of the year.

In addition to being sheltered and undisturbed by boat traffic in the southern portion of Fidalgo Bay, the site offers a plentiful food supply for waterbirds[7], including forage fish, shellfish, other small invertebrates, juvenile salmon and eelgrass. Large populations of wintering Pacific Brant are documented in Fidalgo Bay and exclusively depend on eelgrass as fodder, and need the shallow areas to pull themselves out of the water and collect gravel for digestion. Dabbling ducks (American wigeon, mallards, pintails, and canvasbacks) primarily feed on eelgrass and other submerged aquatic vegetation. (See Appendix B, Table B-1, for a list of observed bird species).

In 2017, the Fidalgo Bay Aquatic Reserve Citizen Stewardship Committee began bird surveys in the southern area of the bay focusing on species and numbers found. Thus far, two seasons of monthly surveys between September and May have identified the largest presence in the bay are duck species, with the three most abundant species in south Fidalgo Bay as bufflehead, green-winged teal and northern pintail.

Several species of birds that specifically use Fidalgo Bay and adjacent areas meet the listing criteria given for species listed by Washington State as Sensitive, Threatened, or Endangered. These are listed below with general status and habitat descriptors:

1. Common loon (*Gavia imm*er) is a State Candidate species that utilizes the shallow protected areas of the reserve for staging and wintering.
2. Bald eagle (*Haliaeetus leucocephalus*) is a federally listed as a Species of Concern. Bald eagle nesting sites are located on Weaverling Spit and along Hwy 20 above the Custom Plywood site. Other nesting sites occur near Fidalgo Bay, primarily, on Hat Island,

[7] Waterbirds: The term waterbird is used to describe birds that occupy and use shallow inland marine bays and salt marsh habitats. These include marine diving ducks and alcids, shorebirds of all kinds, dabbling ducks, gulls, and Brant.

Guemes Island, and on the Marathon Petroleum property (T. Woodard, Samish Indian Nation, personal communication, 2019). Eagles utilize the bay for foraging.

3. Peregrine falcon (*Falco peregrinus*) is a State listed Endangered species and Federally listed as a Species of Concern. Peregrine falcons from active nests near Seafarer's Park (T. Woodard, Samish Indian Nation, personal communication, 2019) and on Guemes Island feed in the bay.
4. Great blue heron (*Ardea herodias*). There is a very large heron rookery located on the southeastern portion of March Point containing over 700 nests. WDFW recommends priority habitat protections for seasonal aggregation (nesting) areas (WDFW PHS Species List 2008).
5. Osprey (*Pandion haliaetus*) nest sites have been located inland in close proximity to the bay. One-mile Island has an osprey nest and osprey regularly feed on fish from the waters of Fidalgo Bay.
6. Marbled murrelet (*Brachyramphus marmoratus*) is a State Endangered and Federal Threatened Species. Annual aerial surveys from 1992–99 (Nysewander, WDFW) consistently observed 1 to 2 marbled murrelets in Fidalgo Bay. More recent observations of marbled murrelets in the area include the National Audubon Society Christmas bird counts by Skagit County Audubon members.
7. Western grebe (*Aechmophorus occidentalis*) is a State Candidate species.

Other species considered at risk species found in the Fidalgo Bay Aquatic Reserve include Vaux's swift and purple martin. In recent years, the American white pelican (State listed as Threatened) has been a regular summer presence nearby in Padilla Bay and nesting has been documented. Fidalgo Bay includes habitat that may attract white pelicans in the future. (T. Manns, Skagit Audubon, personal communication 2019).

Great Blue Heron

Great blue herons are a bird species of particular interest at Fidalgo Bay due to the bay's proximity to a large heron rookery at the southeast portion of the March Point peninsula. This 15-acre property, owned and managed by the Skagit Land Trust, is the largest heron rookery in the State, and has been increasing in size. In 2018, 757 heron nests were counted there. This heronry is becoming more critical for their survival as it becomes larger in size at the expense of other smaller ones (Eissinger 2007). Herons routinely feed on small fish in the shallow waters of Fidalgo Bay, and extensively use the shoreline in the bay including upper intertidal habitat, shoreline perches and riparian vegetation. During diurnal high tide periods, herons seek foraging opportunities in the upper reaches of the intertidal zone. Large woody debris and floating rafts serve as platforms for individual herons foraging at high tide. Areas of undeveloped shoreline offer greater shoreline habitat complexity and less human disturbance for foraging herons. Saltmarshes also provide habitat for both foraging and loafing.

Given unexplained mass abandonment of colonies (Eissinger 2007), major geographic shifts in the breeding population and population decline in certain areas, consistent monitoring and status of the great blue heron population is necessary. Standard methods of data collection both for productivity estimates and accurate post-season colony nest counts are vital to monitoring this population over time. Annual colony monitoring is also necessary to track colony success and changes, since colonies may fail, abandon, fragment or relocate in any given year. The Skagit Land Trust owns most of the

land where the March Point heronry is located and has conducted annual nest counts for many years. The WDFW lists great blue heron nesting colonies as "priority species". The great blue heron rookery at March Point, as one of the largest concentrations of Great Blue Herons on the west coast, is called out by Skagit County as an official Habitat and Species of Importance in SCC 14.24.500(4). The Skagit Land Trust has proposed (July 27, 2018) an update to the Skagit County Critical Areas Ordinance (CAO SCC14.24) to include greater protections for this species and habitat.

Marine Mammals

Eight harbor seal (*Phoca vitulina*) "haul outs" are located in close proximity to Fidalgo Bay. These sites are used year round as resting sites and serve as pup rearing sites from mid-June through mid-August (WDFW). Harbor seals frequently forage in Fidalgo Bay and pups are seen in the bay during the summer months.

Other non-marine mammals are often seen along the shoreline, foraging on the beaches adjacent to the aquatic reserve. A family of river otters raccoons and black-tailed deer are regularly seen been in the south bay along the western shore. Mink and long-tailed weasel have been observed transitioning from the bay to the beach near Weaverling Spit (T. Woodard, Samish Indian Nation, personal communication, 2019).

Part 2. – Current Environmental Conditions and Ecosystem Stressors

This section presents current physical, biological and environmental conditions contributing to the health of the aquatic reserve, with particular focus on the ecosystem stressors affecting organisms and ecosystems of the reserve. Ecological Stressors are physical, chemical, and biological stimuli that impact the condition and integrity of ecosystems and can change the trajectories of species and ecosystems. Stressors can be natural, such as, drought, storms, insect or disease outbreaks, or anthropogenic like climate change, pollution, shoreline alteration, or trampling. (USGS, https://www2.usgs.gov/ecosystems/environments/stressors.html, accessed 2/28/2019). Since the effects of climate change (sea level rise, warming, ocean acidification, and precipitation) act as an overlay on exiting local stressors, a summary of anticipated influences or changes of climate change is presented first. Where relevant, a discussion of restoration and mitigation actions conducted that may help reduce the effects of a stressor are presented along with any information on anticipated added stressors due to climate change.

Effects of Climate Change

Changing climate poses a myriad of potential new, intensifying, or compounding stressors for the organisms and habitats of the reserve. Therefore, likely changes are described below, along with anticipated impacts and associated stressors.

Physical, biological and chemical changes to the marine environment associated with climate change will exacerbate naturally occurring events and conditions in Fidalgo Bay. Current trends in climate change may contribute to the following ongoing fluctuations in ocean conditions (Snover 2013), all of which could have an impact on existing physical and biological resilience in the aquatic reserve area. For example:

- Sea level rise and storm surge will inundate low-lying areas adjacent to the Reserve. This may also result in more shoreline armoring to protect infrastructure.
- Sea level rise (Table 1.) will further submerge current subtidal and intertidal habitat areas, having the potential to adversely affect fish and wildlife resources and associated habitat.
- Rising water temperatures will create additional stressors on marine organisms.
- Lower dissolved oxygen concentrations, related to increases in water temperature, will create additional stressors for fish and at extreme levels can be fatal.
- More frequent and heavy precipitation events can contribute more pollutants and alter water chemistry.
- Eutrophication from increased nutrient loading can intensify the impacts of decreased pH and low dissolved oxygen.
- There is a demonstrated decrease in the upper-ocean pH by 0.1 units and this decline is expected to continue (WBRP 2012a). The rate of ocean acidification is accelerating from anthropogenic carbon emissions and is currently “ten times faster than anything the earth has experienced during the past 50 million years.” (WBRP 2012b). Ocean acidification can interfere with shell and skeleton building for calcifying organisms, such as Olympia oysters and other shellfish. It can also affect biological processes such as bio-sensory

functions in salmon and forage fish, inhibiting their ability to locate natal areas, food sources, and to detect predators.

Sea-level rise due to human-caused climate change is predicted to increase throughout the Salish Sea Region. Based on the "most likely to occur" range of estimates for the 10-year period from 2020 – 2030, sea levels in the Fidalgo Bay area may rise from 2.4 – 5.9 inches (61–150mm), (Miller et al. 2018). For more detail see Table 1 below. This table includes two time periods, two greenhouse gas emission scenarios, and a range of probabilities for more extreme estimates.

Table A-1. Sea Level Rise Projections for Fidalgo Bay

Scenario Year Ending	Emissions Scenario	Most Likely Scenario (increase, in ft.)		Most Extreme Estimate (increase, in ft.)		
		Central Estimate (50%)	Likely Range (83-17%)	10% probability	1% probability	0.1 % probability
2030 (10 yrs. out)	RCP 4.5	*0.3*	*0.2 - 0.5*	*0.5*	*0.6*	*0.8*
	RCP 8.5	*0.3*	*0.2 - 0.4*	*0.5*	*0.6*	*0.7*
2050 (30 yrs. out)	RCP 4.5	*0.7*	*0.4 – 0.9*	*1.0*	*1.3*	*1.9*
	RCP 8.5	*0.7*	*0.5 – 1.0*	*1.0*	*1.4*	*2.0*

Summary of absolute sea level projections, in feet, relative to contemporary sea level for Washington State, for two greenhouse gas scenarios (RCP 4.5 and RCP 8.5) and two time periods, and across a range of probabilities.

Source: Miller, I.M., Morgan, H., Mauger, G., Newton, T., Weldon, R., Schmidt, D., Welch, M., Grossman, E. 2018. Projected Sea Level Rise for Washington State – A 2018 Assessment. A collaboration of Washington Sea Grant, University of Washington Climate Impacts Group, Oregon State University, University of Washington, and US Geological Survey. Prepared for the Washington Coastal Resilience Project. RCP "Representative Concentration Pathways (RCPs)". *IPCC*. Retrieved 11 March 2019.

Compounding the effects of sea-level rise, are increasing storm intensity and frequency that will also produce greater wave energy, more wave run-up, more extreme storm surges, and potential rises in groundwater levels (USGS Puget Sound Coastal Storm Modeling System). These combined effects will cause erosion and alterations to the shoreline and the physical structure in the bay.

Fidalgo Bay is a relatively narrow, confined, "U-shaped" bay, which makes it more vulnerable to the impacts of increased storm intensity and frequency. Effects of this physiographic constriction can include: longer periods of beach habitat exposure to storm conditions, altered substrate composition, increased scour of substrate, changing nearshore bathymetry, burial of or reduced light availability for submerged aquatic vegetation, and damage to adjacent infrastructure and upland vegetation. These conditions may lead to a need for increased armoring to protect infrastructure. The extensive armoring and physical location of adjacent infrastructure in Fidalgo Bay already creates a classic "coastal squeeze" phenomenon, intensifying effects and limiting opportunities to buffer the impacts described above. Such armoring includes transportation infrastructure surrounding the reserve area on three sides (Hwy 20, March's Point Road, and Fidalgo Bay Road), development along the City of Anacortes shoreline, the southern portion of Samish Nation RV Park on Weaverling Spit and two refineries on March Point.

Research to better prepare for and mitigate some of the adverse physical and biological effects of climate change are ongoing in the aquatic reserve. The Samish Indian Nation is working with USGS

to develop a more detailed sea-level rise model, bringing in wave and storm surge data for the area to better inform the community about impacts (T. Woodard, Samish Indian Nation, personal communication, 2019). Washington DNR's Acidification Nearshore Monitoring Network (ANeMoNe) was established in 2015 to measure the progress of acidification and climate change in shallow marine waters across Washington State. Now spanning 10 sites, ANeMoNe supports research that aims to enhance the resilience of marine aquatic resources. At each site, sensors take measurements inside and outside of eelgrass, to test the potential of these plants to counteract acidification at local scales. ANeMoNe overlaps with the WDNR Aquatic Reserves program at Fidalgo Bay, Cherry Point, Maury Island, and Nisqually Reach (M. Horwith Washington DNR, personal communication, 2019).

ANeMoNe also serves as a foundation for a growing number of peer-reviewed publications on topics that range from investigations of practical management options to buffer against acidification to explorations of the causes of shellfish stress (M. Horwith Washington DNR personal communication, 2019). In Fidalgo Bay, biologists from the Swinomish Indian Tribal Community explored whether recycled oyster shells could protect juvenile Manila clams by buffering against ocean acidification. Juvenile Manila clams were grown with and without recycled shells, and with and without kelp or eelgrass present. Recycled shells were effective in reducing acidity and increasing pH in the sediment where the clams live, but had no effect on clam growth. Clams grew more slowly in the presence of kelp or eelgrass. This study improves our understanding of the tools available to counteract acidification at small scales (Greiner et al. 2018).

WDNR and University of Washington scientists measured how Pacific oyster physiology responds to temperature, pH, and the presence of eelgrass. Juvenile Pacific oysters were moved from a hatchery to five ANeMoNe sites, including Fidalgo Bay. After 29 days, the oysters were collected, dissected, and the proteins in their gill tissue were analyzed using novel laboratory techniques. Pacific oyster physiology differed between Puget Sound and a Washington coastal estuary, perhaps reflecting that oysters in the estuary experienced more heat stress. These results help us understand differences in shellfish stress across Washington State, and the potential for particular areas to provide refuge from climate change and acidification (Venkataraman et al. 2019).

WDNR and University of Washington scientists tested the response of geoduck physiology to temperature, pH, and the presence of eelgrass. Juvenile geoducks were transplanted from a hatchery to five ANeMoNe sites, including Fidalgo Bay. Over the following 29 days, eelgrass appeared to reduce acidity and increase local pH, but this had no effect on the geoducks. Instead, geoducks appeared to respond to differences in temperature and dissolved oxygen. This study helps us predict how geoducks and their fishery may respond to warmer and more acidic waters (Spencer et al. 2019).

The State legislature has acted to slow down climate change. In 2008, the Legislature adopted reduction targets for greenhouse gases (commonly known as GHG or carbon pollution). Washington's current targets are to:

- Reduce overall greenhouse gas emissions to 1990 levels by 2020.
- Reduce overall greenhouse gas emissions 25 percent below 1990 levels by 2035.
- Reduce overall greenhouse gas emissions 50 percent below 1990 levels by 2050.

Ecology publishes a greenhouse gas report that helps track progress toward meeting the state's reduction limits, the Washington State Greenhouse Gas Emissions Inventory: 1990–2015. In 2015, Washington's largest contributors of greenhouse gases were:

- Transportation sector — 42.5 percent
- Residential, commercial, and industrial sector — 21.3 percent
- Electricity sector — 19.5 percent

Shoreline Modifications and Overwater Structures

Extensive historic modification of the shoreline, including armoring, filling of intertidal and salt marsh areas, along with effects from overwater structures like the trestle/causeway bisecting the reserve continue to alter the natural processes and ecosystems of the bay, contributing to environmental stressors.

Shoreline Modifications

Williams et al. (2003) report that within Fidalgo Bay, 47 acres have been filled, 8 acres are affected by overwater structures, 45 acres were altered at depth, and approximately 8 acres have been dredged. The shoreline around the bay has been modified extensively by fill and armoring. Armoring adjacent to the aquatic reserve includes the transportation infrastructure surrounding the reserve area on three sides—State Highway 20, March's Point Road, and Fidalgo Bay Road, development along the City of Anacortes shoreline, portions of the RV Park on south Weaverling Spit and two refineries on March Point. Approximately 29,000 feet or 64.7 percent of the shoreline in Fidalgo Bay is armored including 4,800 feet of riprap along both sides of the causeway (Williams 2003).

The most notable structure in the aquatic reserve is the railroad trestle, along with the hardened revetment/causeway crossing the bay. This structure now supports the Tommy Thompson Trail**.** In 1890, when the railroad connection to Anacortes was constructed, the west shoreline of the bay was substantially built-up with fill and hard armoring to enable construction of the railroad tracks**.** Originally, the trestle was wood all the way across. It wasn't until the 1950s that the riprap revetment was constructed, burying the creosote piling substructure of the trestle and armoring the western portion.

Physical Effects

The analysis of armoring by Antrim in 2003, still generally summarizes the present conditions in the reserve area. This includes the continual erosion to Crandall Spit, substrate coarsening on beach faces, loss of substrate elevation along armored shores, and the 2–4 foot elevation gain in areas south of the trestle from the deposition of fine sediments and organic materials (Antrim et al. 2003, Williams et al. 2003).

Historically, Fidalgo Bay was connected to the north end of Similk Bay and at high tide could support shallow vessel traffic. The area was diked, drained, filled, and converted to pasture land. Since filling aquatic lands and habitat conversion occurred early and extensively, the native condition of the shoreline and extent of habitat types in the bay is poorly known (Collins 2005). Severing connectivity to the Whidbey basin not only modified the water, sediment and energy regimes in the bay, but also changed the biological structure of the bay. The presence of Highway 20, directly adjacent to the head of the bay, magnifies the effects of diking and the conversion of wetlands to uplands. The additional filling and associated shoreline armoring further interrupts natural processes including altering and reducing freshwater inflows, as well as, the erosion and accretion of sediments.

The fill and armoring of the western causeway portion of the Tommy Thompson Trail has had multiple significant deleterious effects to the bay. The structure has impeded the natural flow of sediments and water flow, in some areas cutting off water circulation all together. The consequent

and continual decrease in the tidal prism, with no appreciable drift at the head of the bay, has led to significant sediment deposition in this portion of Fidalgo Bay (Aundrea Mc Bride, personal communication, 2007).

Due to continuous bulkheads and other shoreline modifications throughout the bay, there are few remaining natural sources for shoreline sediment. Crandall Spit, adjacent to the reserve at the northern boundary, has been shown to be sediment starved, and the reduction of net shore drift sediment volumes in this part of the bay has caused significant areal loss to the west end of the spit. Similar depletion on the west side of the bay has led to reduced area of Weaverling Spit (Johannessen 2007).

Shoreline modifications, almost without exception, damage the ecological functioning of the nearshore coastal systems (Thom et al. 1994).

Biological Effects of Stressors on Habitat

Because armoring structures modify or cut off the natural sediment supply and water flow, they eventually alter the habitat structure and the biological community at many levels. The culpable physical stressors include shifts to higher wave energy levels that erode the beach face and profile, removing fine sediments and therefore the base for organisms to live in. In a few locations in the bay, the surface sediment has been eroded enough to expose hardpan (Antrim, 2000), which eliminated forage fish spawning substrate and habitat for infaunal organisms, such as clams. It has been shown that clam populations are negatively affected by bulkheading. Significantly lower abundances of clams are found below bulkheads than in otherwise similar adjacent natural areas (Yoshinaka and Ellifrit 1974). D. Penttila (Salish Sea Biological, personal communication, 2019) suggests most of the historical natural shoreline and beaches in the bay supported surf smelt spawning. In spite of extensive historical development including intertidal habitat burial in the northwestern part of the bay, surf smelt have sustained a resilient population in the area.

In addition to changing the configuration of the substrate, shoreline development and armoring often includes the removal of riparian vegetation and large woody debris. Riparian vegetation and large woody debris (LWD) in backshore and upper intertidal areas provide a multitude of functions – structural and biological (Brennan 2005). The loss of available "terrestrially-derived" organic debris, nutrients and insects, as well as shade to upper intertidal areas distress the local ecosystem and species. Shade derived from shoreline vegetation maintains more stable upper intertidal substrate temperatures, protects against desiccation, and moderates conditions for infauna. Penttila (2001) found significantly higher surf smelt egg mortality on unshaded beaches than adjacent shaded beaches. Several dietary studies of marine fish show that salmon benefit the most from riparian vegetation. During out-migration, juvenile salmonids are known to be dependent upon shallow, nearshore waters where insects from the terrestrial environment are important prey species, (Brennan 2005).

Historic and present day loss of aquatic vegetation—from direct burial, dredging, increased turbidity, pollution, commercial and recreational practices—are ubiquitous in the bay. The cascading effect of this type of habitat loss can have long-term consequences, since so many organisms, at several life stages, are dependent on vegetated marine habitat. The filled and riprapped portion of the Tommy Thompson trail and the subsequent increased sediment deposition over decades in portions of the south bay, have reduced or arrested eelgrass growth, contributing to a loss of spawning structure/habitat for Pacific herring.

The long-term biological consequences and cumulative impacts of these activities are broad ranging, tenacious, and difficult to repair. Although some success has been achieved from targeted restoration activities, it is mostly unknown how well or if many of these effects can be rectified.

Overwater Structures

Overwater structures can include any object placed on or above aquatic lands such as jetties, groins, docks, piers, individual pilings, or concrete boat ramps. Within the aquatic reserve these include the major Tommy Thompson trestle/revetment, the Samish RV park concrete boat ramp and a few remnant groins. The overwater structures north of the reserve like the March Point piers and the pipeline and the multiple large marinas also affect physical processes in the bay.

Physical and Biological Effects

Overwater structures block sunlight from penetrating the water column which is necessary for eelgrass to flourish. Shadows from these structures can also affect the migration patterns of certain fish species, particularly juvenile salmonids (Simenstad 1999). In Puget Sound, juvenile Chinook salmon, chum, and pink salmon migrate along the shorelines and feed extensively on shallow water epibenthic invertebrates. However, juvenile salmonids typically avoid shaded areas where predators may be present (Haas 2002).

Overwater structures including boat ramps and groins also disrupt sediment flow down drift. The largest overwater structure and greatest threat to the long-term ecological stability in the bay is the trestle and revetment associated with the Tommy Thompson Trail. As a formidable armored and overwater structure, the adverse effects from the trestle are complex, but include loss and reduction in marine habitat area, shading effects on intertidal vegetation and biota, disruption to sediment and water flow, and contamination from creosote pilings that support the structure.

Restoration, Enhancement and Mitigation of Impacts

Several beach nourishment projects, soft armoring treatments, and other major clean up and restoration projects in the bay have contributed to reducing the stressors discussed above. See Appendix C, Map C–9. Some of the projects are reviewed in previous sections, however a summary with positive impacts that influence the present and future conditions in the aquatic reserve will provide further context for management actions. These include:

1. West March Point beach nourishment project (2010 – 2011) cleaned up, regraded and added sediment, including a special topping of fine gravel “fish mix” to target restoring forage fish spawning habitat. This project included approximately 3,000 feet of beach north of the trestle along the east side of the bay. A minimal amount of riparian vegetation was planted to stabilize sediment, moderate substrate temperatures and improve forage fish egg survival.
2. Three phases of the Samish Indian Nation’s Fidalgo Bay Resort beach property enhancement includes; approximately 1,700 feet of beach restoration with sediment nourishment to restore forage fish spawning habitat; regrading to restore a natural beach slope; and the strategic placement of large woody debris across-shore on the beach to slow down along-shore sediment transport. Removing large imported boulders and riprap and creating a bermed, soft-armored backshore can mitigate some potential effects of sea level rise. Also, backshore riparian vegetation was planted to stabilize the shoreline, create shade, and contribute natural detrital material to shore zone areas.

3. North of the reserve area but within the south flowing drift cell on the west side of the bay are two major contaminant cleanup sites—the Custom Plywood and the Scott Paper mill sites. These sites were multifaceted on many levels with extensive removal of armoring, fill, construction debris, degraded piers and overwater structures, derelict pilings and contaminants.

   From 2011–2013 contaminated sediment and wood waste were removed from the more southerly site—Custom Plywood. Some highlights of this extensive restoration effort include the creation of a small embayment ("pocket estuary"), a naturally graded and re-nourished beach (re-establishing 4,400 feet of functionally habitat-enhanced beach), re-established forage fish spawning habitat, and planting traditional native salt marsh, backshore and riparian vegetation. From 2019–2020 most of the remaining contaminated substrate associated with this project will be permanently capped or remediated. More discussion on the benefits specific to contaminant removal at the site are discussed below in the sediment quality/wood waste section.

   Farther north, the Scott Paper Mill site also included large scale upland, backshore and intertidal debris removal and restoration. As remediation for dredging and associated habitat destruction, a very successful eelgrass restoration project is associated with this more northern site.

4. North of the reserve along the east side of the bay is the Northwest March Point beach nourishment project site. This project included restacking of angular rock which had fallen onto the beach, and the addition of 2,230 tons of beach nourishment to restore forage fish spawning habitat. Spawning surveys have consistently documented surf smelt spawning since the project's completion in 2014 (J. Morgan, Northwest Straits Commission, personal communication, 2019).

A multitude of benefits result from these projects. Biological and physical resilience within the bay is enhanced; and processes and ecological functions all improve by cleaning up and restoring habitat. This is especially true for forage fish spawning habitat and eelgrass beds. In the case of the Scott Mill, eelgrass was successfully planted and has been expanding at a greater rate than anticipated. These actions increase primary productivity, enrich species diversity, help rebuild organism populations, and provide a sediment supply to replenish depleted down-drift-cell locations. Cultural benefits include improving the overall aesthetic value of the bay, providing better public access, renewing community involvement and pride, and providing educational venues for learning about Fidalgo Bay and the value of maintaining healthy ecological systems.

Other potential future projects and actions will continue to improve and restore ecological processes, functions and habitat areas throughout the bay. The 2008 Fidalgo Bay Causeway Feasibility Study presents a variety of trestle and causeway removal scenarios and design alternatives that would reduce ecological stressors and alleviate some of the impacts from the presence of the overwater structure and the revetment. Removal or replacement of portions of the trestle/revetment is a priority for DNR, the Samish Indian Nation, and the City of Anacortes.

Effects of Climate Change on Shorelines and Structures

Shoreline modifications and overwater structures will be physically affected by future climate change due to increased intensity and frequency of storm events, particularly increased sea level elevation in

the bay (see 'Climate change' above). This will demand more regular maintenance of structures, and possibly re-designing and rebuilding structures. Anticipating these changes creates opportunities for reducing stressors by planning for and accommodating these impacts.

Water and Sediment Quality

Ecological stressors from impaired water quality can affect any organisms using the bay and interacting with the water. Water quality impairments or contaminants eventually may settle out into sediments, affecting sediment quality and the organisms regularly in contact with, or making their home in sediments. Contaminants such as wood waste from past industrial and commercial activity can also directly impair sediment quality.

All dredging activity has taken place to the north of the reserve.

Sediment Quality

A handful of sediment sampling efforts have been conducted in Fidalgo Bay near the reserve over the years.

In 1997, prior to establishment of the reserve, DNR hired a consulting firm (Tetra Tech) to provide an environmental assessment of sediment quality for parcels to be acquired by the State from the Skagit Land Trust. This assessment was conducted based on the scope of services and objectives identified by DNR, and in general accordance with the specifications established by American Society for Testing and Materials (ASTM) Standard Practice E 1527-97 for real estate transfer due diligence. Tetra Tech reviewed 14 previous sediment and surface water quality investigations conducted within the project area. For the purposes of this effort, those sampling stations lying within the area south of a line drawn from the northern terminus of the March Point refinery docks to the north tip of Fidalgo Island were identified as being pertinent to the assessment. This area was selected based on proximity to the subject properties proposed for the aquatic reserve, and the potential for current and tidal influences to transport sediment and surface water to the intertidal areas of south Fidalgo Bay. These studies were conducted between 1986 and 1997.

In 1995, Ecology performed sediment sampling within the above stated area. Sample locations were selected based on known or suspected areas of potential upland and offshore impacts. A total of 12 samples were collected within the subtidal and intertidal zone on June 14, 1995. Samples were collected from the top 10 centimeters of substrate and submitted for laboratory analysis. Tests for the presence of semi-volatile organic compounds (SVOCs) and polycyclic aromatic hydrocarbons (PAHs). Results for SVOC, PAH, and polychlorinated biphenyls (PCB) compounds were reported after being normalized, based on total organic carbon. Results for sediment samples analyzed for SVOC and PAH compounds revealed that the detected concentrations were below both sediment quality standards (SQS), and minimum cleanup levels (MCUL). The reported PCB concentration of 40.42 mg/kg exceeded the quality standard but was below the minimum cleanup level. At a sample station located within 0.1 mile north of the railroad trestle, and within an equivalent distance of the eastern shore of the bay, elevated concentrations of total petroleum hydrocarbon (TPH) in the motor oil range were identified, along with exceedances of standards for several PAH constituents. This sample station is near the location of the 1991 crude oil spill. However, the report also states that roadway runoff from a nearby culvert may have contributed to the contaminants present at this location. THP analysis of the sediment samples from the site did not show evidence of crude oil.

Sediment samples analyzed for metals as part of Ecology's studies above revealed that no inorganic elements were present above either of the cleanup standards. However, three winters of Mussel

Watch sampling (data on mussel ingestion of waterborne contaminants) in 2013, 2015 and 2017 off Weaverling Spit, detected increasing levels of Copper, Arsenic, and Cadmium – all still low levels, but slightly trending up in concentration (J. Lanksbury, WDFW, personal communication, 2019).

The Ecology-led bay wide cleanup, more recently focused on the Custom Plywood site north of the aquatic reserve area. For over 100 years, this site hosted wood mill operations producing at various times lumber, boxes, wooden pipes, shingles and plywood. From 1939 to 1992 the large plywood mill took over operations at the site. In 1992, the plywood mill structure (partially constructed of creosote pilings over the bay) burned to the ground and collapsed into the water releasing more wood waste, heavy concentrations of dioxins and other toxic chemicals from treated and burned wood into the nearshore. Wood waste and chemical contaminants were found in high concentrations in the upland soil, groundwater and sediment on the Site, which consists of upland, wetland, intertidal and subtidal in-water areas. The City of Anacortes, Ecology and EPA have conducted several environmental investigations to define the extent and type of contamination.

After analyzing data gaps from previous sediment contaminant investigations in the northern bay, SAIC (2010) conducted supplementary investigations of Fidalgo Bay to determine the extent and potential sources of dioxin and further characterize contaminants found in previous investigations. Dioxin/furan concentrations in some intertidal areas near the former mill site were highest and classified as dioxin hotspots with all surface sediments analyzed in the Custom Plywood Mill nearshore area exceeding regional background. The apparent boundary of dioxin/furan contamination extends beyond the Custom Plywood Mill nearshore area into approximately 590 acres of surface sediment in Fidalgo Bay. Dioxin/furan contamination appears to extend up to one mile from the former mill site in western Fidalgo Bay with decreasing trends in contamination with increasing distance from the site (SAIC 2010). The SAIC study also analyzed clam tissue samples from the intertidal areas in the western bay and found the contamination values for clam tissue varied with co-located sediment contamination values. The greatest values for all tissue contaminants occurred at the locations with the greatest sediment dioxin/furan values (SAIC 2010). Cleanup of this site began in 2011 and most contaminated sediment and wood waste were removed or capped by 2013. Monitoring and further remediation is ongoing with the final phase of capping expected to be completed in 2020.

In 2007, Ridolfi staff collected soil, sediment and surface water samples for the Fidalgo Bay Causeway Feasibility Study (Ridolfi 2008). Sediment samples collected adjacent to the causeway show that copper is the only metal reported at levels greater than the sediment screening level and only in one sample. Several SVOCs, including PAHs were detected at concentrations greater than the screening levels in sediment at the site. The greatest concentrations of PAHs were detected at sediment sample locations adjacent to the trestle, built from creosote treated wood. Fourteen PAHs were detected in samples from this area with concentrations exceeding screening levels by up to one order of magnitude. (Ridolfi 2008).

Threats to Sediment Quality

Although mostly removed or capped at this point, residual contaminants left from the Custom Plywood site and cleanup may pose a threat to overall ecosystem health and recovery. Otherwise, it is difficult to anticipate the potential for other future negative environmental impacts to the reserve area, given the wide range of factors that influence such occurrences (e.g., changes in development and land use scenarios, spill scenarios). Although best management practices for stormwater and wastewater are regulated by the City of Anacortes, direct discharge of polluted stormwater still

occurs at times. Sewage inflow to the bay from future residential, agricultural, commercial or industrial development is possible, but less likely with greater local monitoring and planning efforts.

In addition, the prevailing currents within Guemes Channel and the mouth of the bay appear to limit the potential for future deposition of contaminated sediments into the subject area. The records review conducted for the sediment assessment (Johnson 2000) indicates that the existing commercial and industrial operations in the area are in general compliance with their respective operating, discharge, and air quality permits. The potential for a catastrophic spill incident to occur in the reserve area may be elevated by the presence of the major industrial activities on March Point. However, the number of incidents of this nature has been limited in the past, and prevention and preparedness practices are ongoing at these facilities. Continued efforts to maintain this status will serve to minimize these environmental threats.

As discussed in the following section, as long as creosote pilings remain in the bay there will continue to be ecological exposure and potential impacts from creosote-impaired water quality, and contaminated sediments adjacent to the pilings.

Creosote Pilings

Although over a thousand creosote pilings were removed from the former Custom Plywood Mill site, several areas within the aquatic reserve maintain a prevalence of creosote pilings. There are over 770 remnant creosote pilings as part of the original railroad trestle. Creosote from pilings has been documented to be toxic to some marine biota and can readily leach into the aquatic environment (Vines et al. 2000, Xaio 2002). Chemical testing of sediment, soil, and surface water identified PAHs, a creosote-related set of chemicals in surface sediment samples collected near the trestle pilings. Concentrations exceeded Ecology's sediment management standards. The extent of contamination was not determined either laterally or vertically but it is likely to be limited to a zone within a few feet or few tens of feet of pilings, (Ridolfi 2008). Also, distributed throughout the northeastern tidal flats of the reserve, remnant pilings that held the log rafts are still common in areas. Since creosote pilings represent an ongoing source of contamination, remediating this issue is a management priority for the Fidalgo Bay aquatic reserve. The 2008 Fidalgo Bay Feasibility Study by Ridolfi addresses piling removal and replacement as well as some alternatives.

Wood Waste

Fidalgo Bay once was one of the nation's largest timber distribution points. In Fidalgo Bay, logs by the thousands were dumped into holding areas—called log booms. Historically, log rafting storage practices occurred extensively north of the railroad trestle, on the central east shore and northwest shore of the reserve (during much of the last century through about the 1970s). See Figure 16 and Figure A-2

Presently, a minimal amount of visible primary source wood waste in the reserve is from bark and branches from the large log rafts anchored throughout the bay in the previous century. However, images from that period show errant logs resting on the substrate outside of the booming areas and scattered throughout the bay, including just south of the trestle on the east side. It is probable many of these logs remain buried in the substrate. Other significant wood waste deposits and wood debris pollution from the old Scott Paper Mill operations and the Custom Plywood Mill exacerbated the deleterious repercussions from log rafting practices.

Figure A–2. Aerial photo looking east across Fidalgo Bay from around 1960. Hundreds of logs are rafted together on tidelands just north of the trestle (*Photo courtesy of Anacortes Museum*).

Approximately one mile to the north of Weaverling Spit lies the Custom Plywood Mill site, Ecology's cleanup site closest to the aquatic reserve boundary. As briefly discussed under "Sediment Quality" above, this site was in continuous use as a wood products mill and processing site for over 100 years. A catastrophic fire in 1992 left hundreds of pilings, wood waste, sawdust and charred debris in the bay. Cleanup of this site began in 2011 and most contaminated sediment and wood waste were removed or capped by 2013. Monitoring and further remediation is ongoing with the final phase of capping expected to be completed in 2020.

Presently, a minimal amount of visible primary source wood waste in the reserve is from bark and branches from large log rafts anchored throughout Fidalgo Bay during much of the last century through about the 1970s. However, images from that period show errant logs resting on the substrate outside of the booming areas and scattered throughout the bay, including just south of the trestle on the east side. It is probable many of these logs remain buried in the substrate.

Lingering potential effects from wood waste may persist. Once wood waste covers the native sediment, or the surface sediment mixes with significant amounts of wood waste, then the number and diversity of species decreases—as shown by several studies:

- Populations of suspension feeders may begin to decline when wood waste accumulations approach 1 centimeter (Conlan and Ellis, 1979).

- Bark accumulation greater than 2.5 centimeters may eliminate mollusks and several polychaete species (Jackson, 1986).
- Impacted areas with up to 15 centimeters of wood waste may show a reduced diversity and biomass, with only a few deposit-feeding polychaetes and crustaceans (Conlan and Ellis, 1979).
- The presence of the marine bacteria Beggiatoa species has historically been a good indicator of the organic enrichment that is typical when wood waste is present. Beggiatoa is a filamentous genus of proteobacteria and forms colonies that produce bacterial mats. Beggiatoa is tolerant of high sulfide concentrations, while eelgrass is intolerant of these conditions. Once eelgrass beds are eliminated by the inhospitable environment, Beggiatoa will move into the area. As a rule, Beggiatoa live in low or acidic pH environments. It is unclear whether they themselves produce toxic by-products because of their chemosynthetic activities (Department of Ecology 2013).

Water Quality

Water quality concerns include sources from stormwater, direct runoff from adjacent farmlands, oil spills and contaminants, temperature, pH and nutrient changes from climate change. Pollutants from the impaired air quality may also precipitate directly into the bay (see Air Quality section).

Stormwater

Stormwater is considered one of the biggest contributors to water pollution in the urban areas of Washington State because it is ongoing and damages habitat, degrades aquatic environments, and can have serious impacts on the health of the Puget Sound (Lanksbury 2017).

The city of Anacortes to the west has two combined sewer overflows. These discharge into Guemes Channel to the north and west of the reserve, averaging less than one overflow per year (D. Hennebert, City of Anacortes, personal communication 2019). However, the stormwater collected from city streets and parking lots drain untreated via outfalls into the Fidalgo Bay. Some stormwater ponds and vaults help with stormwater treatment prior to discharge into the bay. Twenty-four of the 32 outfalls that drain directly into Fidalgo Bay are in close proximity to the aquatic reserve area. The Samish Nation DNR in 2005 identified and mapped 43 outfalls representing a wide range of inputs, into the bay. In 2005, the Tribe started sampling the outfall sites including five marine sites intended to assess overall impact of stormwater inputs to the bay. Sites were sampled for nitrogen and fecal coliform contamination. After successive years of sampling, a few outfalls on the west side of the bay intermittently presented high fecal coliform levels. Working with the City of Anacortes, they traced the source of contamination “upstream” and found several residents that had sewer pipes plugged directly into the stormwater system rather than the city sewer. Work with the City of Anacortes to ascertain whether upstream modifications have resolved this particular situation is ongoing. Sampling will continue to provide the needed feedback to assure improved conditions.

In 2010, in collaboration with the City of Anacortes, the Tribe redesigned and expanded its sampling program to include analysis of phosphorus and nitrate/nitrite as well as fecal coliform, DO, pH, temperature and salinity.

In 2013, the Mussel Watch Program was introduced and expanded throughout the inner marine waters of Washington State by WDFW. Three seasons of sampling occurred in the Fidalgo Bay aquatic reserve at Weaverling Spit. The sampling season spanned three winter months from November to February, and included 2013–2014, 2015–16 and 2017–18. Nearshore mussel

monitoring efforts are intended to characterize the extent of contamination present in nearshore biota. The study analyzed the concentration of several major contaminant classes in mussels: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs, or flame retardants), chlorinated pesticides (including DDTs) and six metals (lead, copper, zinc, mercury, arsenic, cadmium) (Lanksbury 2017).

Throughout the Sound, the most abundant organic contaminants measured by Mussel Watch were PAHs, PCBs, PBDEs, and DDTs. PAHs and PCBs were detected in mussels from every site, and the concentrations were significantly higher in Puget Sound's most urbanized areas, as measured both by municipal land-use classification (i.e., cities and unincorporated Urban Growth Areas) and by the percent of impervious surface in upland watersheds adjacent to the nearshore (Table 3). Although lower in overall concentration, PBDEs and DDTs followed a similar pattern (Lanksbury 2017)

In Fidalgo Bay, all three years, the levels of PAHs observed by Mussel Watch were well below the mean in the lowest category and considered not of concern. Also low in overall concentration, PBDEs and DDTs followed a similar pattern. Five of the six metals (lead, being the exception) were found in mussels from all the study sites. However, their concentrations were relatively low in Fidalgo Bay. At the Weaverling Spit site, only cadmium and copper were in a medium category – found in relatively low concentrations but trending upwards over the 3 sampling periods. (J. Lanksbury, WDFW, personal communication, 2019).

Agricultural Runoff

Properties directly upland of the reserve on the east side of the bay are currently used to raise livestock. Typically, livestock grazing areas can introduce nitrogen and other nutrients into adjacent waterways. Fecal coliform contamination from local livestock could affect water quality in the southeastern portion of the bay. Water quality sampling by the Samish Indian Nation DNR has found higher fecal coliform counts in outfalls along March's Point Road. This may be linked to cows grazing on the adjacent hillslope with direct access to ephemeral streams draining into the bay (T. Woodard, Samish Indian Nation, personal communication, 2019).

The landowner raising livestock is working with the Skagit Conservation District to implement Best Management Practices (BMPs) that will improve and protect water quality. The BMPs included in the farm plan include manure storage, heavy use protection area, roof runoff collection, and underground outlets preventing clean rainwater from coming in contact with manure. The District also provides technical assistance for better pasture management that helps maintain good grass production maximizing nutrient uptake and reducing erosion of fine sediments to the bay. The District helps provide cost share funding granted by the Washington State Conservation Commission for the design and construction of recommended BMPs.

NPDES Permits

Through the National Pollution Discharge Elimination System (NPDES) permits, Ecology issues ongoing or one-time permits for actions that impair water quality in our state. Table A–2 below lists the current (i.e. May 2019) NPDES permits for outfalls or upland activities occurring immediately within, adjacent to or near the aquatic reserve (i.e. within 200 m. of shoreline.

Table A–2. NPDES permits issued[8] as of May 2019 within 200m. of Fidalgo Bay shoreline.

NPDES Permittee	Permit Number	Permit Status	Permit Type	Latitude	Longitude	Effective Date	Expiration Date
Trident Seafoods Anacortes	ST0007397	Active	Industrial	48.5190	-122.6171	1/1/2015	12/31/2019
Trident Seafoods Corp 4Th St	WAR000880	Active	Industrial	48.5190	-122.6171	12/1/2015	11/30/2020
Port Of Anacortes	WAR045711	Active	Municipal	48.5200	-122.6108	8/1/2013	7/31/2018
Pier 2 Port Of Anacortes	ST0045500	Active	Industrial	48.5198	-122.6094	6/1/2011	5/27/2016
Dakota Creek Industries	WA0031411	Active	Industrial	48.5190	-122.6074	7/1/2016	4/30/2021
Anacortes Wwtp	WA0020257	Active	Municipal	48.5180	-122.6063	12/1/2017	11/30/2022
City of Anacortes	WAR045549	Active	Municipal	48.5175	-122.6008	8/1/2013	7/31/2018
Pacific Marine Center	WAG994368	Active	Boatyard	48.5029	-122.6071	11/1/2017	7/31/2021
Marine Servicenter	WAG030095	Active	Boatyard	48.5021	-122.6065	8/8/2016	7/31/2021
Cap Sante Marine South	WAG030022	Active	Boatyard	48.4982	-122.6019	8/8/2016	7/31/2021
Tesoro Refining & Marketing Company Llc	WA0000761	Active	Industrial	48.4914	-122.5688	3/1/2015	2/29/2020
Tesoro Anacortes Refinery Project	WAR305728	Active	Construction	48.4914	-122.5688	8/25/2017	12/31/2020
Bnsf Fidalgo Yard Improvements	WAR303273	Active	Construction	48.4707	-122.5680	1/1/2016	12/31/2020
Sharpes Corner Vicinity Improvements	WAR305732	Active	Construction	48.4638	-122.5818	9/5/2017	12/31/2020
Shell Oil Products Us Puget Sound Refining Co	WA0002941	Active	Industrial	48.4676	-122.5701	1/1/2017	12/31/2021
Scimitar Ridge Ranch	WAG503162	Active	Sand and Gravel	48.4641	-122.5816	9/5/2017	12/31/2020
Pier 2 Port Of Anacortes	ST0045500	Draft	Industrial	48.5198	-122.6094	6/1/2011	5/27/2016
Custom Plywood Mill	ST0045503	Draft	Industrial	48.4946	-122.6009	-	-
Grand Firs Division 3 & 4	WAR301460	Draft	Construction	48.4914	-122.5688	3/5/2015	12/31/2019

Effects of Water Quality Stressors on Species and Habitats

Both water and sediment quality can have deleterious effects on organisms, from acute to chronic, from minor to the complete death of organisms. Contaminants like heavy metals and some organic compounds can have carcinogenic and mutagenic effects. Excess nutrients can change important geochemical cycles and biological processes, affecting the quality and quantity of available habitat.

A major oil spill, while unlikely due to many safeguards now in place, could affect Fidalgo Bay's ecosystems and organisms in many ways, with recovery varying from days to years. If a spill were to occur, the potential impact of a major oil spill on the regional great blue heron population could be devastating due to the close proximity of the heron colony and foraging areas to refinery operations.

[8] List based on a query of Ecology's Permitting and Reporting Information System (PARIS). Web site accessed May13, 2019. https://apps.ecology.wa.gov/paris/MapSearch.aspx

The largest breeding colony in the state and its associated feeding areas are located adjacent to the March Point facilities.

For many decades hundreds of creosote pilings have impacted water and sediment quality in the bay. Creosote pilings can be toxic to some life stages of marine organisms. Researchers from the Bodega Marine Lab at University of California / Davis, found that nearly all herring eggs collected from creosote pilings at their study site failed to develop properly and died (Estuary 1997). Furthermore, there was an effect observed on spawn deposited near the pilings as well. Egg hatching success was found to be reduced by 50 percent at creosote concentrations of 50 parts per billion (ppb). However, in Fidalgo Bay no herring spawn has been observed to date on creosoted pilings.

Restoration, Enhancement and Mitigation of Impacts

Along with habitat creation and restoration at the former Custom Plywood Mill site, Ecology has completed extensive cleanup and/or capping of all contaminants. The final phase of dioxin/furan contaminant capping will be completed by 2020 (A. Fernandez, Ecology, personal communication, 2019). A brief summary of the cleanup and beneficial actions include:

- *Phase 1.* Removal of all remaining structures, surface debris, excavating wood waste and removal of contaminated soil, backfilling with clean sediment and constructing a wetland mitigation area with stormwater swale.
- *Phase 2.* In-water cleanup including dredging and capping wood waste (deposits greater than 1 foot deep below the mudline) and areas of dioxin concentration greater than 25 ppt. and experimental thin layer capping in eelgrass beds.
- *Phase 3.* Sub-tidal remediation capping of remaining areas with dioxin greater than 10 ppt. and areas with conspicuous remaining wood waste. Phase 3 consists of approximately 10.5 acres of aquatic sediment; 4.7 acres support eelgrass with about 0.38 acres eelgrass mitigation/planting.

The long-term benefits from the removal and isolation of contaminated sediments will improve or restore many critical life phases for invertebrates, fishes, birds, and marine mammals in the bay. The affected environments have already demonstrated a net increase in function, such as an increase in surf smelt spawning habitat and increased biota on intertidal beaches. Expected benefits from this cleanup, realized and future, also include reduced risks to human health, an increase to aesthetic, recreational, educational, and cultural opportunities.

Potential Future Drivers Affecting Water and Sediment Quality

Future large-scale, human "drivers" that could increase ecological stressors were discussed in this management plan Section 2—Ecosystem Description, Human Impacts and Stressors. Additional detail not contained in that section is provided below.

Climate change

The increased frequency and intensity of storm events may re-suspend or move contaminated sediments in the bay, or overwhelm stormwater treatment facilities creating pulses of toxic releases into the bay. Climate change is anticipated to lower the pH of the bay (due to increased carbon in the atmosphere), affecting shellfish reproductive capacity and biological success as well as causing potential shifts in biological community structure and populations. Warmer water temperatures will affect nutrient dynamics and basic respiration of organisms by reducing oxygen. Lower freshwater

upland recharge capacity may reduce freshwater inputs coming into the bay during the summer, affecting nearshore salinity.

Contaminants and Oil Spills

Since the reserve is in close proximity to Highway 20, county roads, several marinas and commercial facilities, including boat building and repair facilities, and the two refineries, an accidental discharge or spill of pollutants into the bay is possible. As the population increases, more vehicular traffic will be generated along Hwy 20 and roads around Fidalgo Bay creating increased sources of stormwater pollution and possible spill incidents.

Two oil refineries on March Point currently operate adjacent to the eastern boundary of the reserve. The northern refinery is now owned by Marathon Petroleum; the southern by Shell Oil. Together, the two refineries have a combined production of a quarter million gallons of product per day (2018 websites). Raw materials and products are shipped by rail, truck, tanker ship, barge, and underground pipelines. Potential sources of petroleum spills into Fidalgo Bay include:

- Ships and bulk transport facilities in the bay (including more than 7,500 feet of elevated pier transport piping),
- Underground liquefied natural gas pipelines directly east and south of the reserve,
- Railroad tank cars on rail lines directly east of the reserve, and
- Trucks transporting petroleum products on March's Point Road (which runs adjacent to the entire eastern boundary of the reserve).

The refineries, in cooperation with state and federal regulatory agencies and the Tribes have established spill response plans and contingencies in case of an oil spill. The Washington Department of Ecology last updated its Geographic Response Plan for North Puget Sound in 2012. This plan, which is currently being updated, establishes initial response priorities and booming strategies to protect sensitive areas and resources of the Bay. Protection of Crandall and Weaverling Spits is a priority. The Swinomish Indian Tribal Community has a lot of oil spill response equipment and along with the Samish Indian Nation, actively participate in oil spill response drills and other planning and training events. Recently, the Department of Ecology Oil Spill Response Team, in collaboration with Samish Indian Nation, awarded money for them to purchase a boat to aid in Oil Spill response. The boat will be delivered in May 2019, and will enable trained tribal staff to transport spill response and NRDA personnel in Samish traditional territory in the case of a spill. Other potential spill related boat benefits include use as a transport asset for potential wildlife rescue efforts during any spill in the area (T. Woodard, Samish Indian Nation, personal communication, 2019).

Spills have occurred over the 60 years of refinery operations and may occur in the future. The former Texaco refinery (now owned by Shell) had four separate oil spill events in 1991–1992 spilling more than 560 barrels (23,500 gal.) of crude oil into the bay. Beaches, intertidal areas, birds and cultural resources in the southern portion of the bay were affected by oil and/or cleanup operations from these spills. Following cleanup and remediation, reports by the Department of Ecology showed no significant residual contamination (Johnson 1997, 2000). A Natural Resources Damages Settlement was awarded in 2004 for damages associated with these spills, providing money for a 2008–09 beach restoration along portions of the reserve's eastern boundary which were damaged by oil.

Air Quality

The Washington Department of Ecology Air Quality Program manages smoke, car pollution, industrial emissions, and other pollutants so communities have healthy air to breathe. The Air Quality Program issues permits, enforces state regulations, and maintains a reporting system intended to keep air pollution at healthy levels.

The Northwest Clean Air Agency is the primary government agency responsible for protecting the air in Island, Skagit and Whatcom counties. They are responsible for monitoring sulfur dioxide in the March Point area. In (YEAR), a records review conducted by Tetra Tech for DNR indicated that the existing commercial and industrial operations were in general compliance with their respective operating and air quality permits. However, there have been several ”upsets” reported at both refineries with reported air quality falling below permitted standards during power outages or equipment failures, or during shut down and start up times.

According to the Washington Air Quality Monitoring Network website; https://fortress.wa.gov/ecy/enviwa/ (accessed 2/8/19), two air monitoring sites in Anacortes nearest to refinery operations have recorded “low threat” or “good” air quality values with minimal air pollution. Air quality monitoring found the air quality in the area of Fidalgo Bay on average as “so good there is little health risk.”

Effects of Air Pollution on Species and Habitat

Air pollution can include gas or particulates from major sources like personal and commercial vehicles (especially those traveling on Highway 20), wood stoves, ferries, ships and trucks associated with refineries, emissions from industrial shipbuilding or refinery operations. Various polluting constituents may precipitate out directly into the bay, or concentrate in stormwater runoff. While Washington has strong air pollution regulations, there have been occasional emergencies and accidental releases of air pollution in excess of regulatory requirements. As the human population of the area continues to grow, or if industrial or refinery operations expand in the future, the air quality in the reserve could be affected.

Non-Native Species

Fidalgo Bay and adjacent environs have been colonized by a wide variety of non-native species. The variety of species, their abundance, and impacts to native populations have not been fully described and in many circumstances are not fully known. While ecological functions and benefits can be prescribed to virtually all species, including non-native invasive species, the habitat and biological community changes that result from the establishment and spread of invasive species can adversely impact native species. Invasive species are broadly recognized as the second leading cause of losses of Threatened and Endangered species, after habitat destruction (Pimental et al. 2000). To date, no systematic survey has been attempted to assess which species are within the reserve boundaries.

Some non-native species were deliberately introduced to the region through aquaculture such as, Pacific oysters *(Crassostrea gigas).* Other non-natives were accidently introduced along with the Pacific oyster, including Manila clams (*Venerupis philippinarum*), Japanese eelgrass *(Zostera japonica*), the Pacific oyster drill (*Ocinebrellus inornatus*), and Asian mud snail (*Battilaria attramentaria*). The Asian mud snail was first recorded in Padilla Bay in the 1960s, however the invasion likely occurred sometime earlier. Today, the Asian mud snail is the most abundant macrofauna on mudflats in both Padilla (PSWQAT 2000) and Fidalgo Bays. Exclusion experiments suggest that *Battilaria* may facilitate the invasions of other non-native species including another mud snail (*Nassarius faterculus*) (Wonham et al. 2003). The purple varnish clam (*Nuttallia obscurata*)

was apparently introduced via ballast water from Asia and is common on several beaches in the reserve area. Varnish clams tend to inhabit the upper one third of the intertidal zone, decreasing in the middle and lower intertidal zone. (WDFW website, https://wdfw.wa.gov/ais/nuttalia_obscurata/ 2019).

In September 2016, a few invasive European green crabs (*Carcinus maenas*) were found in neighboring Padilla Bay. This recently introduced exotic species has the potential for great habitat destruction and could severely injure Washington State's oyster, clam, mussel, and Dungeness crab populations and industries, among others (Holmes 2001).

From April–September 2018, the Samish Indian Nation DNR and Washington Sea Grant (WSG) Crab Team carried-out monthly surveys for European green crab at two sites in Fidalgo Bay. Green crabs were not found during any of these surveys. However, in August 2018, while doing forage fish surveys on the east side of the bay, a Puget Sound Corps staff found a green crab carapace on the beach at Little Crandall Spit in the aquatic reserve. As a result, WDFW's Nuisance Species Program set out an aggressive trapping array in accessible and likely habitat areas in the most southern portion of the bay, but did not trap any green crab. The Samish DNR and WSG crab team will proceed with the seasonal monitoring program in 2019 at the two sites in the bay. The Tribe will continue to carry out future green crab surveys beyond 2019 if funding and priorities allow. WDFW and WSG are committed to monitoring and controlling the spread of green crab in Washington's marine and estuarine waters and will persist in regularly monitor in Fidalgo Bay and neighboring areas to curtail green crab establishment.

Spartina anglica was first discovered in Fidalgo Bay in 1999 with two smaller infestations in the bay, along the southeastern shore and in the Fidalgo Bay Resort RV park inner bay of Weaverling Spit; both areas were reportedly treated and eradicated (2005). The Skagit County noxious weed crew regularly monitor the bay and have removed small infestations of *Spartina* in the same general locales.

Puget Sound Expedition (Cohen et al. 1998) was a collaborative rapid assessment of non-indigenous species in Puget Sound, and had an assessment site at Cap Sante Marina. Although this site is located within Fidalgo Bay, it is 1.4 miles north of the reserve boundary. Several invasive species listed below were observed. Most of these are known to degrade the quality of the habitat and/or compete with native species. Non-native species observed or present at Cap Sante Marina include:

1. *Spartina anglica*
2. *Zostera japonica*
3. Bryozoan (*Bugula*)
4. Tunicate (*Botrylloides violaceus*)
5. Japanese littleneck (*Venerupis phillipenarum*)
6. Pacific Oyster (*Crassostrea gigas*)
7. Horn shell snails (*Battillaria attramentaria)*
8. Varnish Clam (*Nutallia obscurata)*

Potential Impacts

Some invasive, non-native species may cause ecological disruption by competing with native species and changing ecosystem structure. In the case of the aquaculture industry, these changes may cause significant economic losses as well. Monitoring and control of potentially harmful species is essential for maintaining the existing health status of the bay. Several non-native invasive species pose a continual threat to physical and biological habitat areas and functions within the bay. Since *Spartina*

is an invasive aquatic plant species that can degrade the quality of the tide flats, threaten native marsh communities and encroach on critical shorebird and juvenile salmon habitat, vigilant monitoring and eradication are necessary. *Sargassum muticum* can out compete native kelp species and become a monoculture. *Sargassum* is present in northern parts of the bay, but generally not a threat in the aquatic reserve due to the lack of coarse gravel/cobble substrate. For several of the other non-native species, the long-term detrimental effects are undetermined or controversial.

As discussed in the preceding section, the recent expansion of European green crabs to Padilla Bay and the molt on the beach in Fidalgo Bay warrants collaborative and diligent surveying and trapping efforts in the bay. In areas where the green crab has established reproducing populations, they have had dramatic impacts on other species, like smaller shore crab, snails and small oysters. While the crab cannot crack the shell of a mature Pacific oyster, it can prey upon young oysters, and will dig down six inches to find clams to eat. One green crab can consume 40 half-inch clams a day, as well as other crabs its own size. As previously mentioned, green crabs can and do consume Dungeness at up to their own size, according to laboratory studies (Cohen et al. 1995, Grosholz and Ruiz 1995, as cited by Cohen and Carlton 1995). Since Dungeness crabs spend part of their early life in the intertidal zone, they may be at risk of predation by green crabs during that time (WDFW, https://wdfw.wa.gov/ais/carcinus_maenas/ 2019). As nursery habitat for Dungeness crab and with the reintroduced Olympia oysters in the bay, a potentially expanding population of green crab in the region is of major concern and could have devastating effects to these species.

Reintroduced Olympia oyster populations could be vulnerable to periodic surges in local populations of Pacific oysters, it is therefore important to monitor for this species. Pacific oysters out compete Olympia oysters for settlement substrate, which is limited in Fidalgo Bay. Additionally, a surge in the Pacific oyster population in the bay could be accompanied by the invasive Asian and/or eastern oyster drills. Other non-native species that are in close proximity to the aquatic reserve, such as the tunicates found at marinas in the bay, can pose a threat by enveloping substrates used for settlement by oysters and other indigenous sessile species and stifling native species.

The non-native polychaete worm *Clymnella torquata* (bamboo worm) is a more recent invader of Samish Bay flats and poses a serious threat to the quality of substrate and the ecology of the existing epibenthic and infaunal communities in areas with extensive sand and mudflats.

Habitat Disturbance by Humans

Ecological stressors can include disturbance of habitat by humans. Physical disruption of foraging and resting habitat, noise and light levels can impact habitats.

Physical disruption may include activity from boaters or kayakers in the bay, or recreationists using the Tommy Thompson Trail. Lights from refinery activities may affect portions of the bay, in turn affecting nocturnal behaviors. As the future population of the area increases, without mitigation measures stressors from human disturbance could increase.

Appendix B – Observed Species List

Tables A–1 to A–5 identify the documented flora and fauna within the area of the Fidalgo Bay Aquatic Reserve.

The species lists include birds, fish, marine mammals, invertebrates, and intertidal and shallow subtidal marine vegetation. Various organizations and individuals who use the area in and around the Fidalgo Bay Aquatic Reserve have identified the species listed below.

These are preliminary species lists, not comprehensive lists. Only species observed and documented by a confirmed source were included.

Table B–1: Birds Observed in Fidalgo Bay Aquatic Reserve

* Species protected by the Federal Migratory Bird Treaty Act
◊ Birds Characteristic of Saltwater Habitat[6]
⊕ Birds Characteristic of Sandy and Gravel Shoreline, Mud Flats and Salt Marshes[6]
Species of Concern Status (State and Federal) was obtained from Washington Department of Fish and Wildlife in 2019.[7]

Common Name	Scientific Name	State Status	Federal Status	Source
Waterfowl - Anseriformes				
Northern Pintail ◊	*Anas acuta*		*	1, 2, 3, 4, 5, 8, 10
Common Teal	*Anas crecca*		*	1, 2, 3, 4, 10
Mallard ◊ ⊕	*Anas platyrhynchos*		*	1, 2, 3, 4, 5, 8, 10
Snow goose	*Anser caerulescens*		*	1, 3, 4, 7, 8, 10
Lesser Scaup	*Aythya affinis*		*	1, 3, 4, 8, 10
Ring-necked Duck	*Aythya collaris*		*	1, 3, 4, 8, 10
Greater Scaup ◊	*Aytha marila*		*	1, 3, 4, 5, 7, 8, 10
Brant ◊ ⊕	*Branta bernicla*		*	1, 2, 3, 4, 5, 8, 10
Canada Goose ◊ ⊕	*Branta canadensis*		*	1, 2, 3, 4, 5, 8, 10
Bufflehead ◊	*Bucephala albeola*		*	1, 2, 3, 4, 5, 7, 8, 10
Common Goldeneye ◊	*Becephala clangula*		*	1, 2, 3, 4, 5, 7, 8, 10
Barrow's Goldeneye ◊	*Becephala islandica*		*	1, 2, 3, 4, 5, 8, 10
Long-tailed Duck	*Clangula hyemalis*		*	1, 3, 4, 7
Trumpeter Swan	*Cygnus buccinator*		*	1, 3, 4, 7, 8
Harlequin Duck ◊ ⊕	*Histrionicus histrionicus*		*	1, 3, 4, 5
Hooded Merganser ◊	*Lophodytes cucullatus*		*	1, 2, 3, 4, 5, 8, 10
American Wigeon ◊ ⊕	*Mareca americana*		*	1, 2, 3, 4, 5, 8, 10
Eurasian Wigeon ◊ ⊕	*Mareca penelope*		*	1, 3, 4, 5, 7, 8, 9
American Wigeon x Eurasian Wigeon ◊ ⊕	*Mareca* sp.			5, 7
Gadwall	*Mareca strepera*		*	1, 3, 4, 8, 10
Black Scoter ◊	*Melanitta nigra*		*	1, 3, 4, 5, 7
Surf Scoter ◊	*Melanitta perspicillata*		*	1, 2, 3, 4, 5, 7, 8, 10
Common Merganser ◊	*Mergus merganser*		*	1, 3, 4, 5, 8, 10

Common Name	Scientific Name	State Status	Federal Status	Source
Red-breasted Merganser	*Mergus serrator*		*	1, 3, 4, 5, 7, 8, 10
Ruddy Duck	*Oxyura jamaicensis*		*	1, 2, 3, 4, 5, 8, 10
Northern Shoveler	*Spatula clypeata*		*	1, 3, 4, 8, 10
Loons – Gaviiformes				
Common Loon	*Gavia immer*	Sensitive	*	1, 2, 3, 4, 5, 7, 8, 9, 10
Pacific Loon	*Gavia pacifica*		*	1, 2, 3, 4, 5, 7, 10
Red-throated Loon	*Gavia stellata*		*	1, 3, 4, 5, 7, 8, 10
Grebes – Podicipediformes				
Western Grebe	*Aechmophorus occidentalis*		*	1, 2, 3, 4, 5, 8, 10
Horned Grebe	*Podiceps auritus*		*	1, 2, 3, 4, 5, 7, 8, 10
Red-necked Grebe	*Podiceps grisegena*		*	1, 2, 3, 4, 5, 8, 10
Pied-billed Grebe	*Podilymbus podiceps*		*	1, 3, 4, 5, 7, 8, 10
Pelicans, Cormorants and Allies – Pelicaniformes				
Double Crested Cormorant	*Nannopterum auritus*		*	1, 2, 3, 4, 5, 8, 10
White Pelican	*Pelecanus erythrorhynchos*		*	1, 3, 7, 4, 9
Pelagic Cormorant	*Urile pelagicus*		*	1, 3, 4, 5, 8, 10
Brandt's Cormorant	*Urile penicillatus*		*	1, 3, 4, 5, 7, 8
Herons, Ibises and Allies – Ciconiformes				
Great Blue Heron	*Ardea herodias*		*	1, 2, 3, 4, 5, 7, 8, 9, 10
American Bittern	*Botaurus lentiginosus*		*	1, 3
New World Vultures, Hawks, Falcons and Allies – Falconiformes				
Cooper's Hawk	*Accipiter cooperii*		*	1, 3, 4, 7, 8, 10
Turkey Vulture	*Cathartes aura*			6
Merlin	*Falco columbarius*	Candidate	*	1, 3, 4, 5, 7, 8, 9, 10
Peregrine Falcon	*Falco peregrinus*	Sensitive	*Delisted	1, 3, 4, 5, 7, 8, 9, 10
Bald Eagle	*Haliaetus leucocephalus*	Sensitive	*Delisted	1, 2, 3, 4, 5, 7, 8, 9, 10
Osprey	*Pandion haliaetus*			6
Shorebirds, Gulls, Auks and Allies – Charadriiformes				
Black Turnstone	*Arenaria melanocephala*		*	1, 3, 4, 5, 7, 8, 10

Common Name	Scientific Name	State Status	Federal Status	Source
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	*Threatened	1, 3, 4, 5, 6, 9, 10
Sanderling	*Calidris alba*		*	1, 3, 4, 5, 7, 10
Dunlin	*Calidris alpina*		*	1, 3, 4, 5, 8, 10
Western Sandpiper	*Calidris mauri*		*	1, 3, 4, 5, 7, 8, 10
Pigeon Guillemot	*Cepphys columba*		*	1, 3, 4, 5, 8, 10
Snowy Plover	*Charadrius nivosus*	Endangered	*Threatened	1, 3, 91
Killdeer	*Charadrius vociferus*		*	1, 3, 5, 6, 8, 10
Black tern	*Childonias niger*		*	1, 3
Northern Harrier	*Circus hudsonius*		*	1, 3, 4, 7, 8, 10
Caspian Tern	*Hydroprogne caspia*		*	1, 3, 4, 5, 7, 9, 10
Mew Gull	*Larus canus*		*	1, 3, 4, 5, 8, 10
Ring-billed Gull	*Larus delawarensis*		*	1, 3, 4, 8, 10
Glaucous-winged Gull	*Larus glaucescens*		*	1, 3, 4, 5, 8, 10
Western Gull	*Larus occidentalis*		*	1, 3, 4, 5, 8, 10
Bonaparte's Gull	*Larus philadelphia*		*	1, 3, 4, 5, 10
Long-billed Dowitcher	*Limnodromus scolopaceus*		*	1, 4, 7, 10
Black-bellied Plover	*Pluvialis squatarola*		*	1, 3, 4, 7, 10
Greater Yellowlegs	*Tringa melanoleuca*		*	1, 3, 4, 5, 8, 10
Flycatchers, Songbirds and Allies – Passeriformes				
Red-winged blackbird	*Agelaius phoeniceus*		*	1, 3, 4, 5, 8, 10
American Crow	*Corvus brachyrhynchos*		*	1, 3, 4, 5, 10
Common Raven	*Corvus corax*		*	1, 3, 4, 7, 8, 10
Brewer's Blackbird	*Euphagus cyanocephalus*		*	1, 3, 4, 8, 10
Willow Flycatcher	*Empidonax traillii*		*	1, 3, 4
Song Sparrow	*Melospiza melodia*		*	1, 3, 4, 5, 8, 10
Savannah Sparrow	*Passerculus sandwichensis*		*	1, 3, 4, 5, 10
Purple Martin	*Progne subis*	Candidate	*	1, 3, 4, 5, 7, 10
Yellow Warbler	*Setophaga petechia*		*	1, 4, 5, 7
Common Starling	*Sturnus vulgaris*			1, 4, 5, 10
Swifts - Caprimulgiformes				
Vaux's Swift	*Chaetura vauxi*	Candidate	*	1, 3, 4, 9

Sources:

1. IUCN 2018. *The IUCN Red List of Threatened Species. Version 2018-2.* http://www.iucnredlist.org. Downloaded on 31 January 2019.

2. Marine Bird Abundance in the Cherry Point and Fidalgo Bay Aquatic Reserves 2013-2018 Appendices.
3. Migratory Bird Treaty Act Protected Species List. U.S. Fish and Wildlife Service. 2013.
4. Sullivan, B.L., C.L. Wood, M.J. lliff, R.E. Bonney, D. Fink, and S. Kelling. 2009. Ebird: a citizen-based bird observation network in the biological sciences. Biological Conservation 142: 2282-2292.
5. *The Birds of Vashon Island: A Natural History of Habitat & Population Transformation* by Ed Swan (2nd Edition)
6. Todd Woodard, Samish Indian Nation on 2/5/2019. Personal communication.
7. Skagit Audubon Society bird counts. 2015-2019.
8. National Audubon Society Christmas Bird Count; Skagit Audubon - Padilla Bay Christmas Bird Count. 2008-2018.
9. Washington Department of Fish and Wildlife. Species of concern. Olympia (WA): Washington Department of Fish and Wildlife; [cited 15 Feb 2019]. Available from http://wdfw.wa.gov/conservation/endangered/
10. Williams, B.W., S. Wyllie-Echeverria, A. Bailey. 2003. Historic Nearshore Habitat Change Analysis for Fidalgo Bay and Guermes Channel. Prepared for the City of Anacortes by Batelle Marine Sciences Laboratory. Sequim WA. 29 pp. + Appendices.

Table B–2: Fish Observed in Fidalgo Bay Aquatic Reserve

Common Name	Scientific Name	State Status	Federal Status	Source
Ratfishes or Chimaeriformes - Chimaeriformes				
Spotted Ratfish	*Hydrolagus colliei*			2, 3
Herrings - Culpeiformes				
Pacific Herring	*Clupea pallasii*	Candidate	Species of Concern	2, 3, 4, 5
Sticklebacks and Seamoths – Gasterosteiformes				
Tube-snout	*Aulorhynchus flavidus*			3, 4
Three-spined stickleback	*Gasterosteus aculeatus*			4
Smelts – Osmerifromes				
Surf Smelt	*Hypomesus pretiosus*			4
Perch-likes – Perciformes				
Pacific Sand Lance	*Ammodytes personatus*			3, 4
Penpoint Gunnel	*Apodichthys flavidus*			3, 4
Shiner Perch	*Cymatogaster aggregata*			3, 4
Snake Prickleback	*Lumpenus sagitta*			3
Crescent Gunnel	*Pholis laeta*			3, 4
Saddleback Gunnel	*Pholis ornata*			3, 4
Pile Perch	*Rhacochilus vacca*			3
Flatfishes – Pleuronectiformes				
Speckled Sanddab	*Citharicthys stigmaeus*			3, 7
Rock Sole	*Lepidopsetta bilineata*			3, 7
English Sole	*Parophrys vetulus*			4, 7
Starry Flounder	*Platichthys stellatus*			3, 4, 7
Salmons – Salmoniformes				
Pink Salmon	*Oncorhynchus gorbuscha*			4
Chum Salmon	*Oncorhynchus keta*	Candidate	Threatened	4, 5
Coho Salmon	*Oncorhynchus kisutch*	Candidate		2,5
Chinook Salmon	*Oncorhynchus tshawytscha*	Candidate	Threatened	2, 4, 5
Scorpionfishes and Flatheads – Scorpaeniformes				
Buffalo Sculpin	*Enophrys bison*			1
Pacific Staghorn Sculpin	*Leptocottus armatus*			3
Great Sculpin	*Myoxocephalus polyacanthocephalus*			3, 4
Tidepool sculpin	*Oligocottus maculosus*			1
Lingcod	*Ophiodon elongatus*			4, 5
Tadpole sculpin	*Psychrolutes paradoxus*			4
Copper Rockfish	*Sebastes Caurinus*	Candidate		3, 4
Pipefishes and Seahorses – Sygnathiformes				
Bay Pipefish	*Sygnathus griseolineatus*			4

Sources:

1. Cherry Point and Fidalgo Bay Aquatic Reserves Intertidal Monitoring Report Appendices 2013-2018; p. 39-49: https://www.aquaticreserves.org/wp-content/uploads/CPAR_FBAR_Intertidal_Monitoring_Report_2019_Appendices_FINAL.pdf
2. IUCN 2018. The IUCN Red List of Threatened Species. Version 2018-2. http://www.iucnredlist.org. Downloaded on 31 January 2019.
3. Miller, B.S., and Borton, S.F. 1980. Geographical distribution of Puget Sound fishes: maps and data source sheets. Volumes 1 and Seattle (WA): Fisheries Research Institute, College of Fisheries, University of Washington.
4. REEF. 2018. Reef Environmental Education Foundation Volunteer Survey Project. Key Largo (FL): REEF; [cited 8 Feb 2019]. Available from http://www.reef.org/db/reports/geo.
5. Samish Indian Nation; Fidalgo Bay Nearshore Fish Use 2015-2017.
6. Washington Department of Fish and Wildlife. Species of concern. Olympia (WA): Washington Department of Fish and Wildlife; [cited 15 Feb 2019]. Available from http://wdfw.wa.gov/conservation/endangered/
7. Washington Department of Fish and Wildlife staff.

Table B–3: Mammals Observed in Fidalgo Bay Aquatic Reserve

Common Name	Scientific Name	State Status	Federal Status	Source
North American River Otter	*Lutra Canadensis*			1, 2, 4
Long-tailed Weasel	*Mustela frenata*			5
American Mink	*Neovison vison*			1, 2, 5
Black-tailed Deer	*Odocoileus hemionus*			5
Northern Raccoon	*Procyon lotor*			1, 2
North Pacific Harbor Seal	*Phoca vitulina richardii*		*	1, 2, 3, 4

* Species protected by the Federal Marine Mammal Protection Act

Sources:

1. IUCN 2018. The IUCN Red List of Threatened Species. Version 2018-2. http://www.iucnredlist.org. Downloaded on 21 February 2019.
2. Ebird; Skagit Audubon Society bird counts. 2015-2019.
3. Lance, M. M., Chang, W-Y., Jeffries, S. J., Pearson, S. F., & Acevedo-Gutiérrez, A. (2012). Harbor seal diet in northern Puget Sound: Implications for the recovery of depressed fish stocks. Marine Ecology Progress Series, 464, 257-271. http://dx.doi.org/10.3354/meps09880
4. The Whale Trail. 2018. The Sites > Washington Park (WA): The Whale Trail; [cited 8 Feb 2019].
5. Todd Woodard, Samish Indian Nation on 2/5/2019. Personal communication.

Table B–4: Invertebrates Observed in Fidalgo Bay Aquatic Reserve

Common name	Scientific Name	State Status	Federal Status	Source
Cnidarians				
Aggregating Anemone	Anthropleura elegantisima			8
Plumrose or Frilly Anemone	Metridium senile			8
Segmented Worms - Annelida				
Bamboo Worm	Axiothella rubrocincta			8
Arrow Worm	Chaetognatha floreana			8
Spiny-skinned Animals - Echinodermata				
Purple Sea Star	Pisaster ochraceous			8
Crustaceans (Barnacles, Crabs and Allies) - Arthropoda, Crustacea				
Acorn Barnacle	Balanus glandula			1, 2, 3
Giant Barnacle	Balanus nubilus			2, 5
Red Rock Crab	Cancer productus			2,3,5,8
Crabs	Cancer spp.			1,
Skeleton Shrimp	Caprella amphipod			1
Small Brown Barnacle	Chthamalus dalli			1, 2
Shrimp	Crangon sp.			1
Purple Shore Crab	Hemigrapsus nudus			1, 2, 3
Shrimp	Heptacarpus spp.			1, 3
Graceful Rock Crab	Metacarcinus gracilis			8
Dungeness Crab	Metacarcinus magister			2, 3, 5
Pink Ghost Shrimp	Neotrypaea californiensis			1
Graceful Decorator Crab	Oregonia gracilis			1
Dock Shrimp	Pandalus danae			1
Graceful Kelp Crab	Pugettia producta			3
Isopods and Amphipods - Arthropoda, Isopoda/Amphipoda				
Amphipod	Allorchestes angusta			1, 2, 3
Amphipod	Eogammarus oclairi			1, 2, 3
Pill Bug Isopod	Gnorimosphaeroma oregonensis			1
Eelgrass Isopod	Pentidotea resecata			3
Rockweed Isopod	Pentidotea wosnesenskii			8
Beach Hopper	Orchestia traskiana			8
Clams, Oysters and Allies - Mollusca, Bivalve				
Heart Cockle	Clinocardium nuttalii			1, 2, 5
Pacific Oyster	Crassostrea gigas			1
Slipper Shell	Crepidula dorsata			3
Pacific Littleneck Clam	Leukoma staminea			1,2,3,5,8

Common name	Scientific Name	State Status	Federal Status	Source
Baltic Macoma	Macoma balthica			5
Bent-nosed Macoma	Macoma nasuta			5
Eastern soft shell Clam	Mya arenaria			5
Pacific blue mussel	Mytilus trossulus			2, 3
Purple Varnish Clam	Nuttallia obscurata			5, 8
Olympia Oyster	Ostrea lurida			6
Washington Butter Clam	Saxidomus gigantea			1, 2, 3, 5
Horse/Gaper Clam	Tresus spp.			2, 3
Manila Clam	Venerupis philippinarium			1, 2
Rough Piddock	Zirfaea pilsbryi			8
Snails and Slugs - Mollusca, Gastropoda				
Carinate Dove Shell	Alia carinata			8
Japanese Mud Snail	Batillaria attramentaria			8
Bubble Shell	Hamonea vesicula			2, 3, 8
Top Snail	Lirularia lirularia			2
Checkered Periwinkle	Littorina scutulata			1, 2, 3
Sitka Periwinkle	Littorina sitkana			1, 2, 3
Finger Limpet	Lottia digitalis			1, 2, 3
Shield Limpet	Lottia pelta			1, 2, 3
Mask Limpet	Lottia persona			1, 2
Hooded Nudibranch	Melibe leonina			7, 8
Chitons - Mollusca, Polyplacophora				
Mossy Chiton	Mopalia mucosa			1, 2

Sources:

1. Cherry Point and Fidalgo Bay Aquatic Reserves Intertidal Monitoring Report Appendices 2013-2018: https://www.aquaticreserves.org/wp-content/uploads/CPAR_FBAR_Intertidal_Monitoring_Report_2019_Appendices_FINAL.pdf
2. Intertidal Monitoring in the Fidalgo Bay Aquatic Reserve 2013 Monitoring Report: http://file.dnr.wa.gov/publications/aqr_resv_fb_2013_intertidal_monitoring.pdf
3. IUCN 2018. The IUCN Red List of Threatened Species. Version 2018-2. http://www.iucnredlist.org. Downloaded on 31 January 2019.
4. REEF. 2018. Reef Environmental Education Foundation Volunteer Survey Project. Key Largo (FL): REEF; [cited 8 Feb 2019]. Available from http://www.reef.org/db/reports/geo.slug
5. Samish Indian Nation DNR shellfish surveys, 2009-2018.
6. Skagit County Marine Resources Committee annual Report 2017: http://www.skagitmrc.org/media/36282/2017%20SMRC%20Annual%20Report6.pdf
7. Todd Woodard, Samish Indian Nation on 2/5/2019. Personal communication.
8. WDNR staff

Table B–5: Aquatic Vegetation Observed in Fidalgo Bay Aquatic Reserve

Common Name	Scientific Name	State Status	Federal Status	Source
Brown Algaes - Orophyta				
Winged Kelp	*Alaria marginata*			2,
Oyster Thief	*Colpomenia bullosa*			
Seersucker	*Costaria costata*			
Broad Acid Weed	*Desmarestia ligulata*			
Maiden's Hair	*Ectocarpus* sp.			
Rockweed	*Fucus gardneri*			2,
Bull Kelp	*Nereocystis luetkeana*			2, 5
Sugar Wrack Kelp	*Saccharina latissima*			1, 2,
Wireweed, Japanese Weed, Sargassum	*Sargassum muticum*			1
Whip Tube, Soda Straws	*Scytosiphon lomentaria*			1
Brown Algae	*Scytosiphon simplicissimus*			
Green Algaes – Chlorophyta				
Green Rope	*Acrosiphonia* spp.			1
Mekong Weed	*Cladophora* sp.			2,
Gut Weed	*Ulva intestinalis*			1, 2, 3
Sea Lettuce	*Ulva lactuca*			1, 2, 3
Bright Grass Kelp	*Ulva linza*			2, 3
Red Algaes – Rhodophyta				
Red Algae	*Agardhiella tenera*			1, 3, 4
Beautiful Leaf Seaweed	*Callophyllis* spp.			4,
Turkish Towel	*Chondracanthus exasperatus*			2,
Crustous Coralline	*Corallinales* spp.			2, 4
Red Algae	*Gracilaria* spp.			2, 3, 4
Red Spaghetti	*Gracilariopsis* spp.			1, 4
Turkish Washcloth	*Mastocarpus papillatus*			1, 2, 4
Iridescent Seaweed	*Mazzaella splendens*			4,
Red Algae	*Petalonia fascia*			3,
Red Algae	*Pyrioia lanceolata*			3,
Lobster Horns	*Polysiphonia* sp.			1, 4
Diatoms	*Navicula distans*			
Flat sea brush	*Odonthalia washingtonensis*			
Nori	*Porphyra* spp.			1, 2, 4
Red String Algae, Sea Noodles	*Sarcodiotheca gaudichaudii*			2,
Seagrass Kaver	*Smithora naiadum*			2, 3
Vascular Plants – Anthophyta				

Common Name	Scientific Name	State Status	Federal Status	Source
Dwarf Eelgrass	*Zostera japonica*		Invasive	2, 4, 5
Eelgrass	*Zostera marina*			1, 2, 4, 5
Salt Marsh Plants – Sedges, Amaranthaceae, Morning-glories, Grasses, Daisy Family, Plantains				
Silver Burr Ragweed	*Ambrosia chamissonis*			
Fat-hen	*Atriplex patula*			1,
Lyngby's sedge	*Carex lyngbyei*			
Salt Marsh dodder	*Cuscuta salina*			6
Tufted Hairgrass	*Deschampsia cespitosa*			1, 6
Salt Grass	*Distichlis spicata*			1,6
American Dunegrass	*Leymus mollis*			1,6
Saltwort	*Glaux maritima*			6
Gumweed	*Grindelia integrifolia*			6
Seaside plantain	*Plantago maritima*			6
Pickleweed	*Salicornia virginica*			6
Cordgrass	*Spartina anglica*			
Chairmaker's Bulrush	*Schoenoplectus americanus*			6

Sources:

1. Cherry Point and Fidalgo Bay Aquatic Reserves Intertidal Monitoring Report Appendices 2013-2018; p.39 - https://www.aquaticreserves.org/wp-content/uploads/CPAR_FBAR_Intertidal_Monitoring_Report_2019_Appendices_FINAL.pdf
2. [DNR] Washington State Department of Natural Resources. 2014. Washington Marine Vegetation Atlas. Olympia (WA): Washington State Department of Natural Resources, Nearshore Habitat Program.
3. Intertidal Monitoring in the Fidalgo Bay Aquatic Reserve 2013 Monitoring Report: http://file.dnr.wa.gov/publications/aqr_resv_fb_2013_intertidal_monitoring.pdf
4. IUCN 2018. The IUCN Red List of Threatened Species. Version 2018-2. http://www.iucnredlist.org. Downloaded on 21 February 2019.
5. REEF. 2018. Reef Environmental Education Foundation Volunteer Survey Project. Key Largo (FL): REEF; [cited 8 Feb 2019]. Available from http://www.reef.org/db/reports/geo.slug
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Appendix C – Maps

Table of Contents:

Base Map Data Sources:

Bathymetry and Topography: Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State. University of Washington, (http://www.ocean.washington.edu/data/pugetsound/)

Fidalgo Bay Aquatic Reserve: DNR

State-owned aquatic land is derived from DNR ownership index plates and does not represent actual spatial extent of tidelands and shorelands. Bedlands are not separately represented on this map, however are included within the areas represented by the tideland and shoreland classifications.

Extreme care was used during the compilation of this map to ensure accuracy. However, due to changes in data and the need to rely on outside sources of information, the Department of Natural Resources cannot accept responsibility for errors or omissions, and, therefore, there are no warranties which accompany this material.

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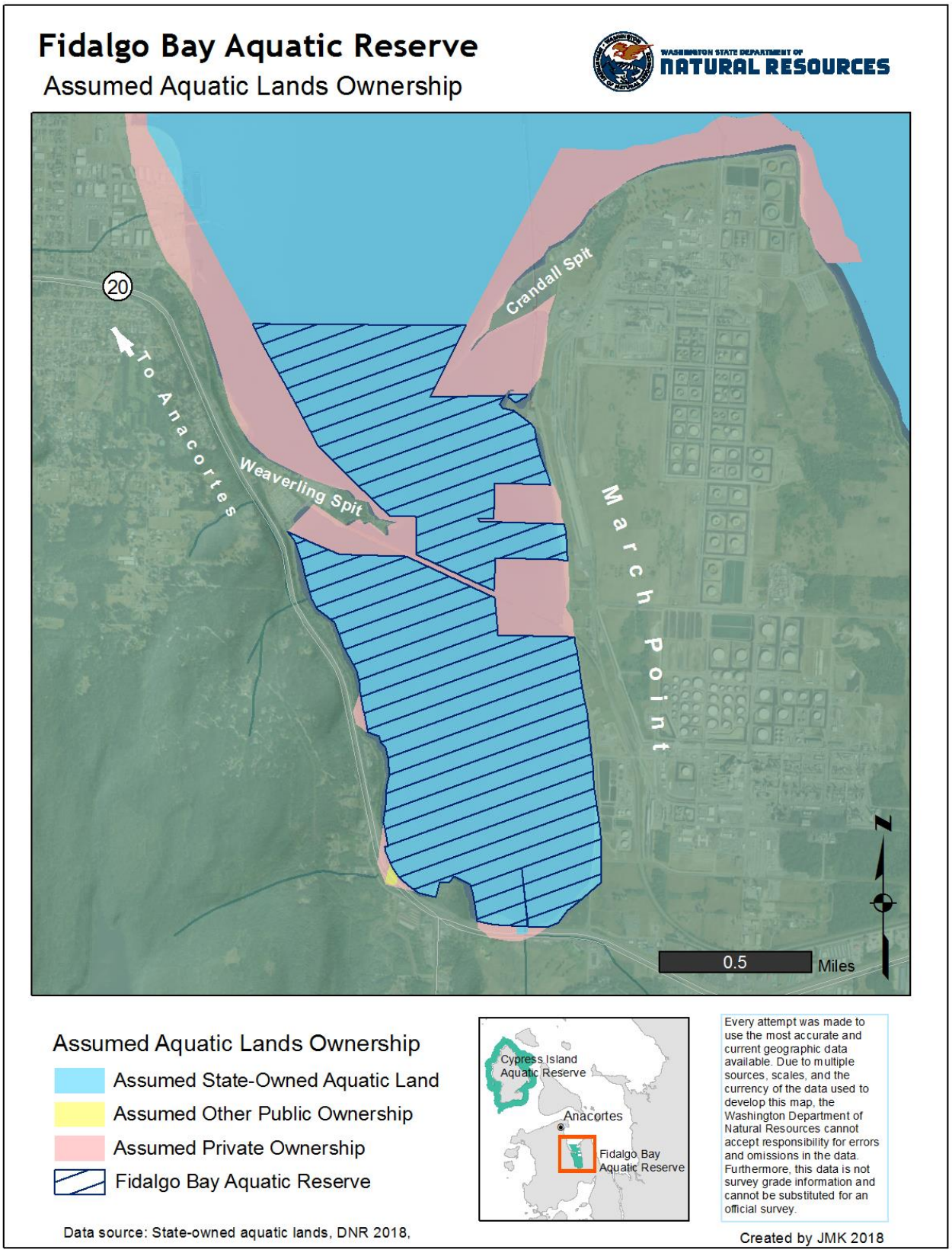
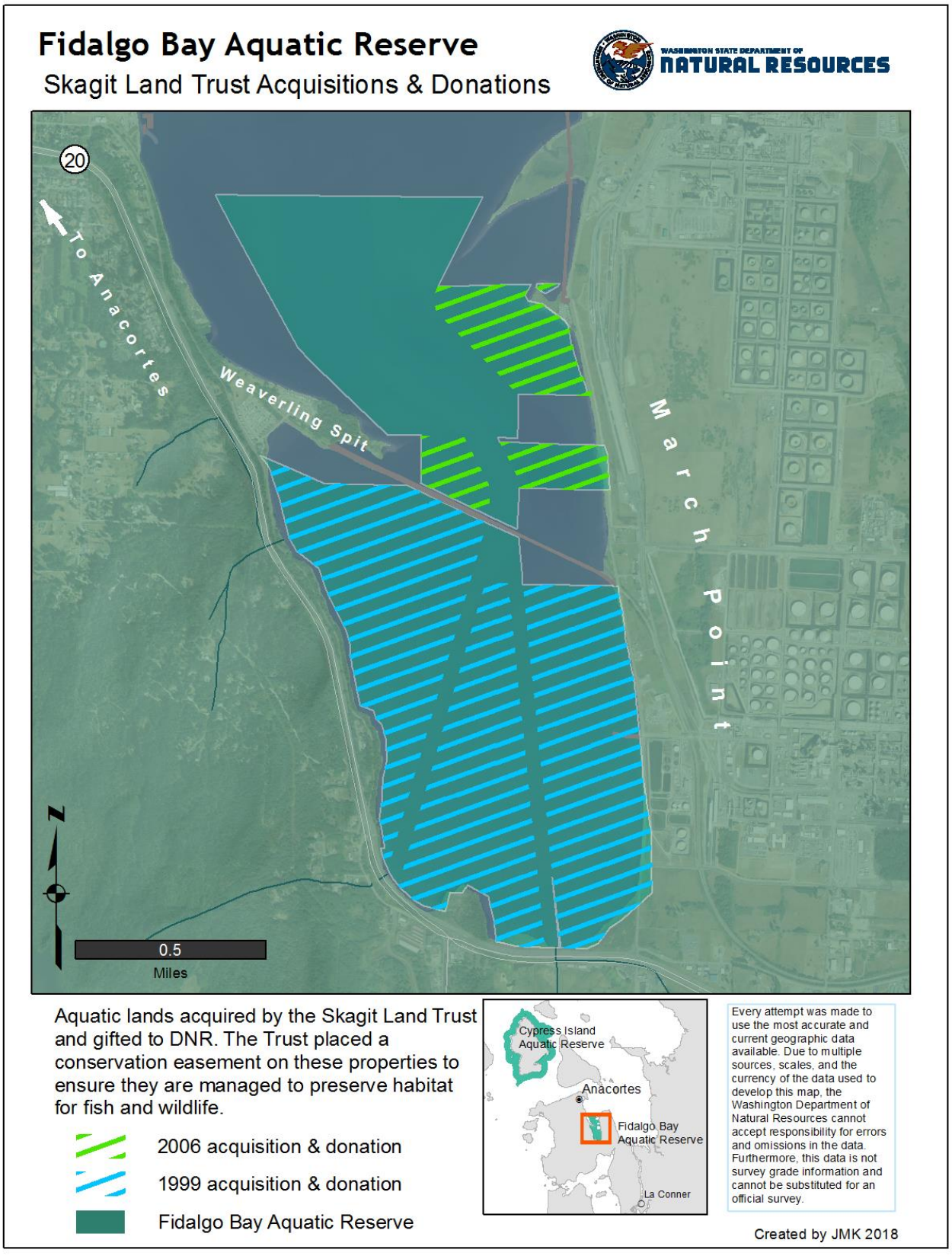
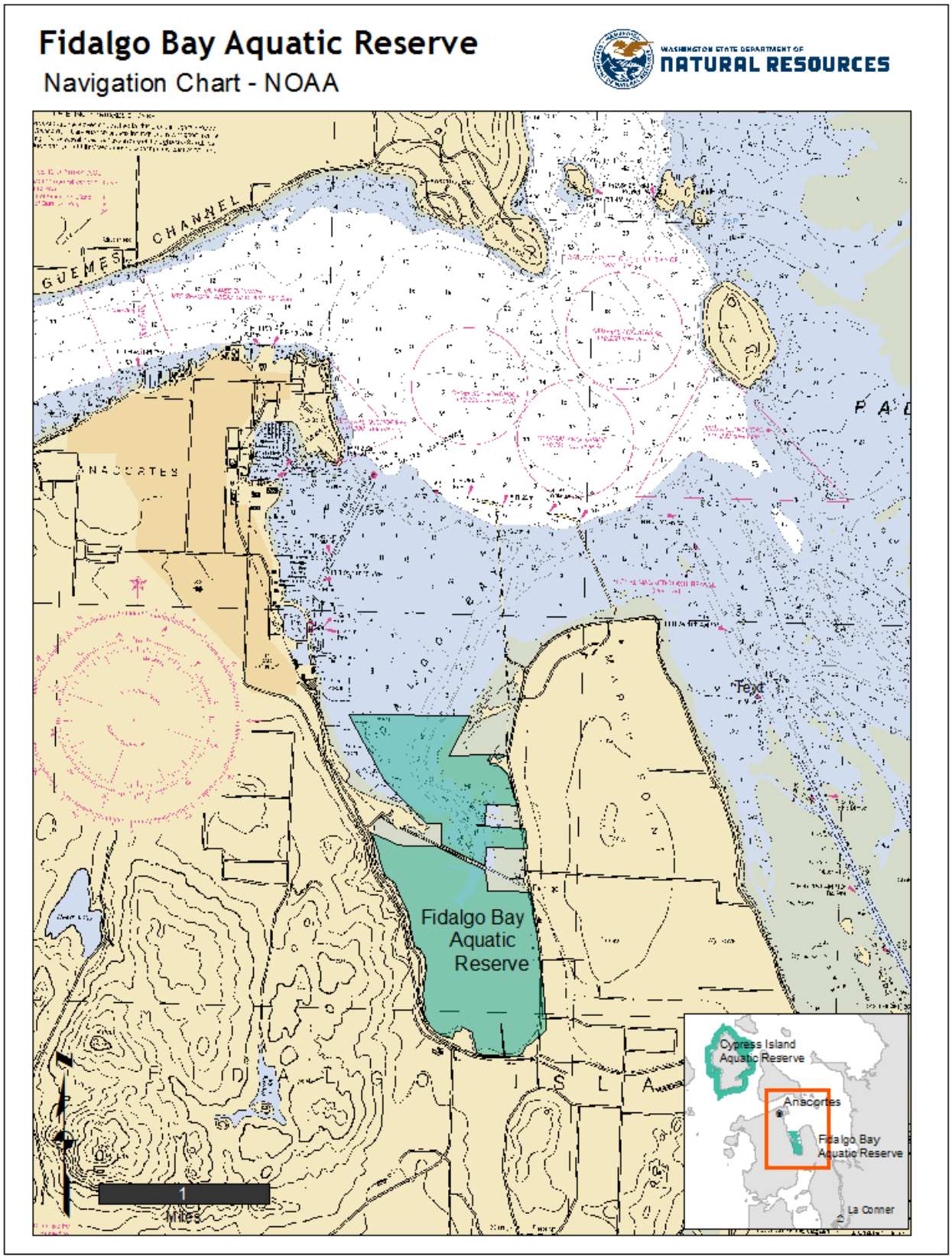
Map C–1: Assumed aquatic lands ownership



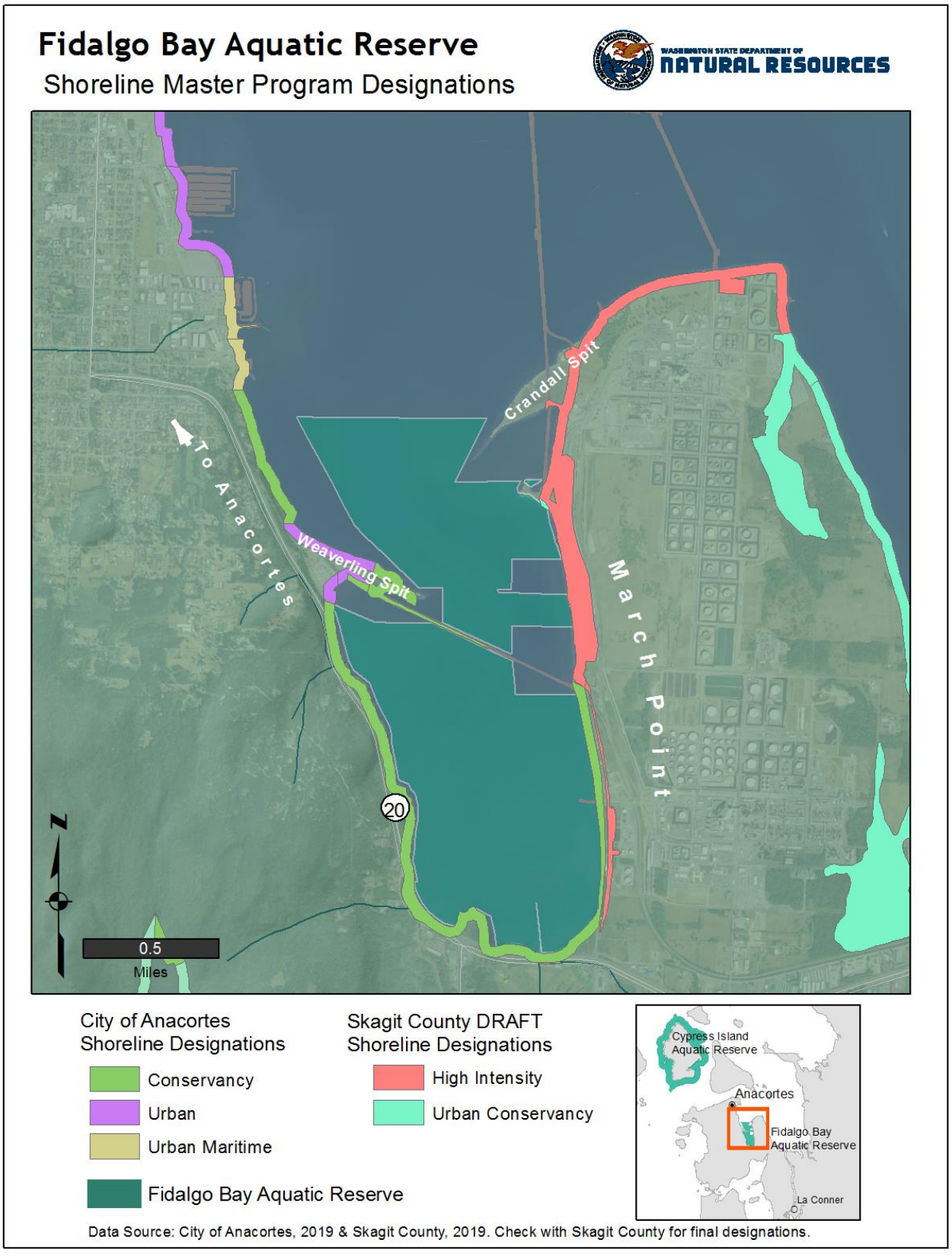
Map C–2: Skagit Land Trust Acquisitions and Donations



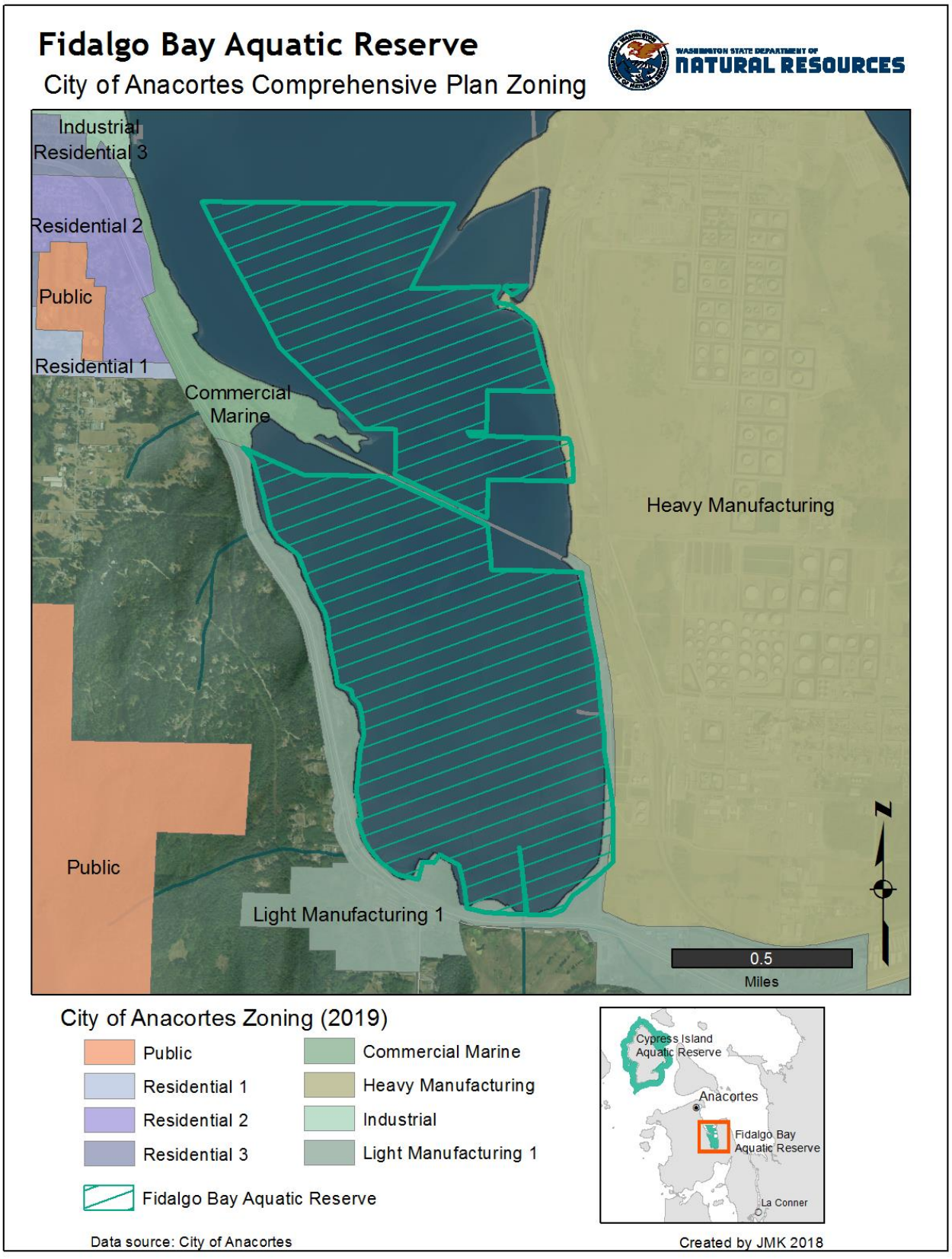
Map C–3: NOAA Navigation Chart



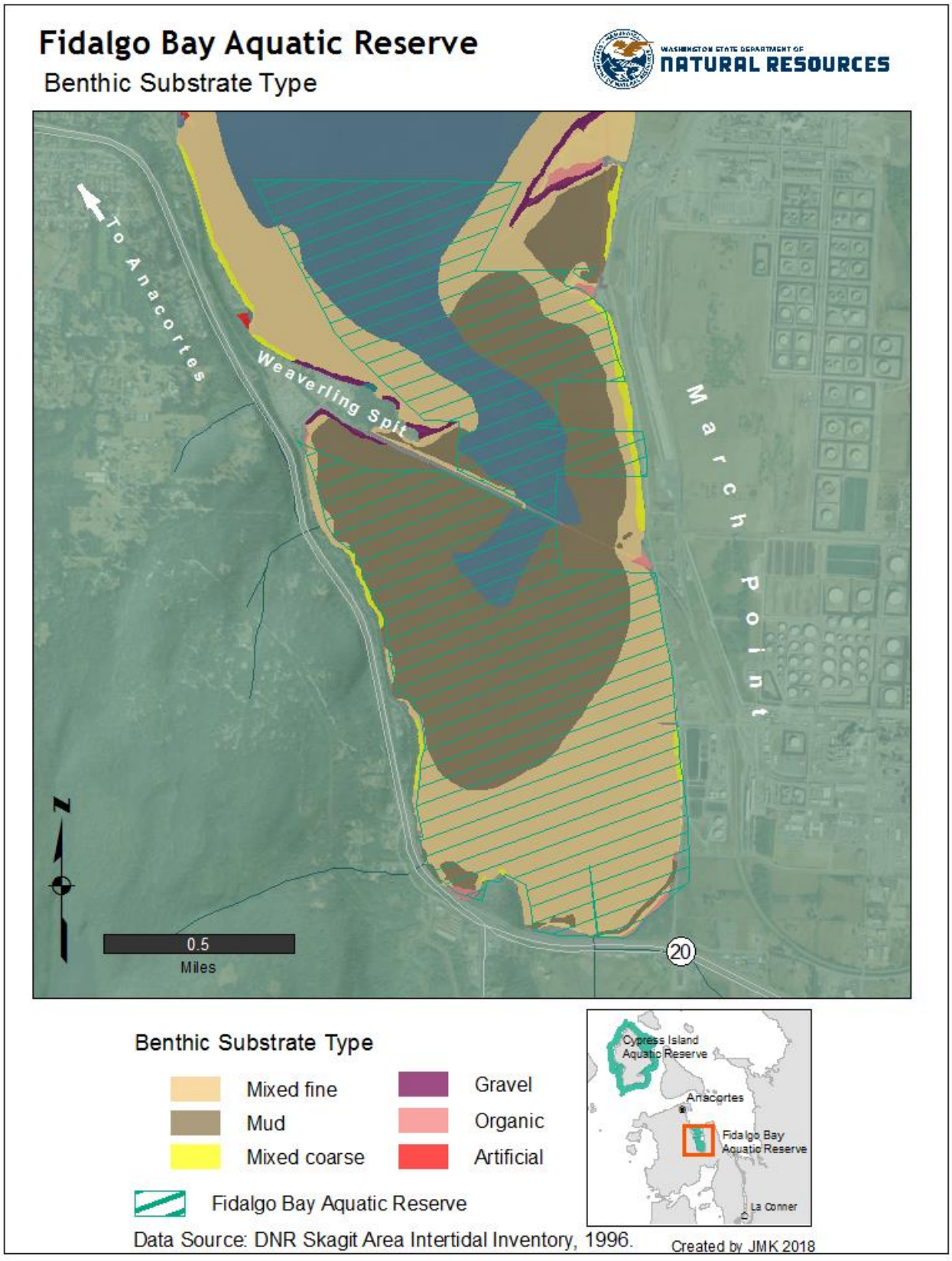
Map C–4: Shoreline Designations



Map C–5: City of Anacortes Zoning

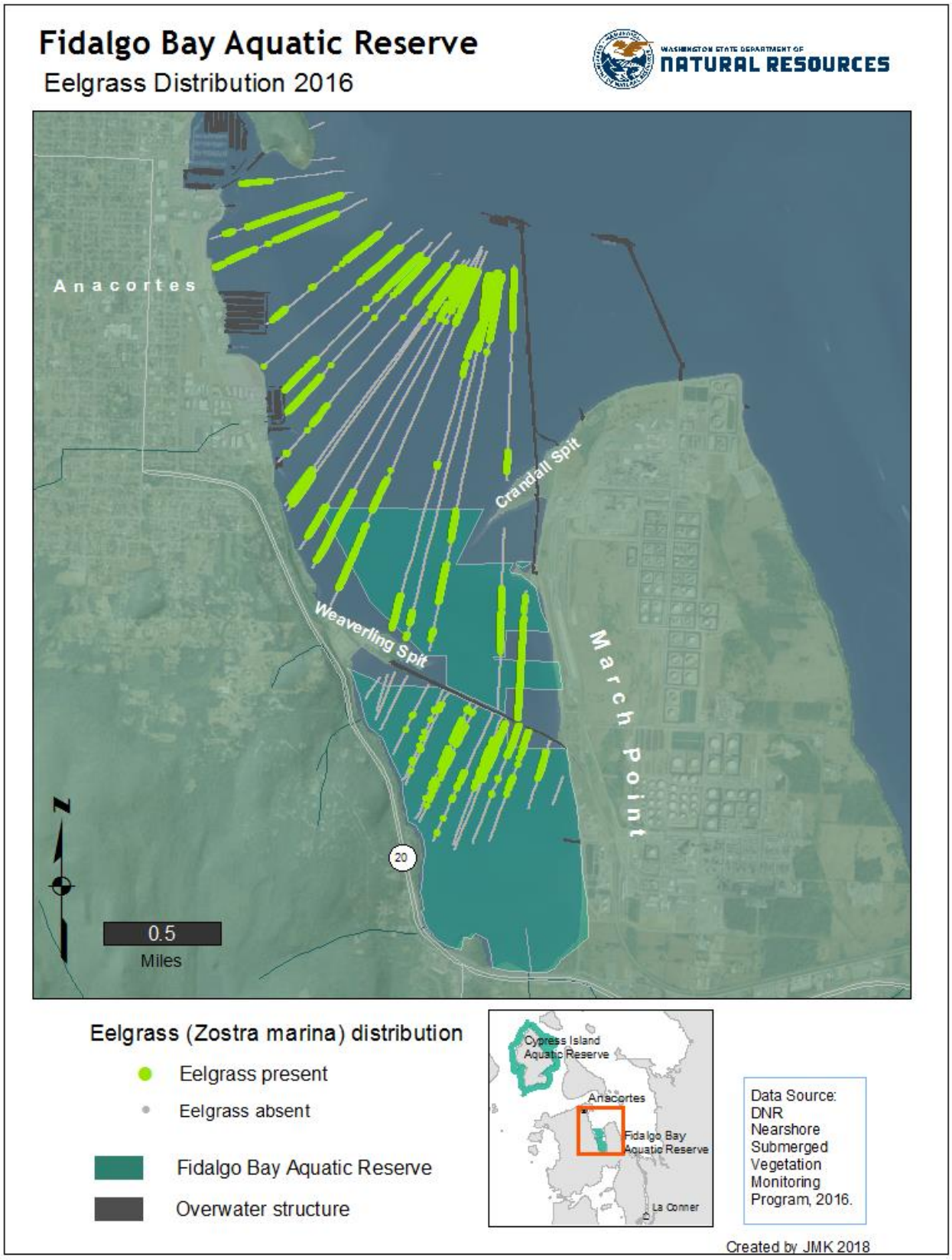


Map C–6: Benthic Substrate Types

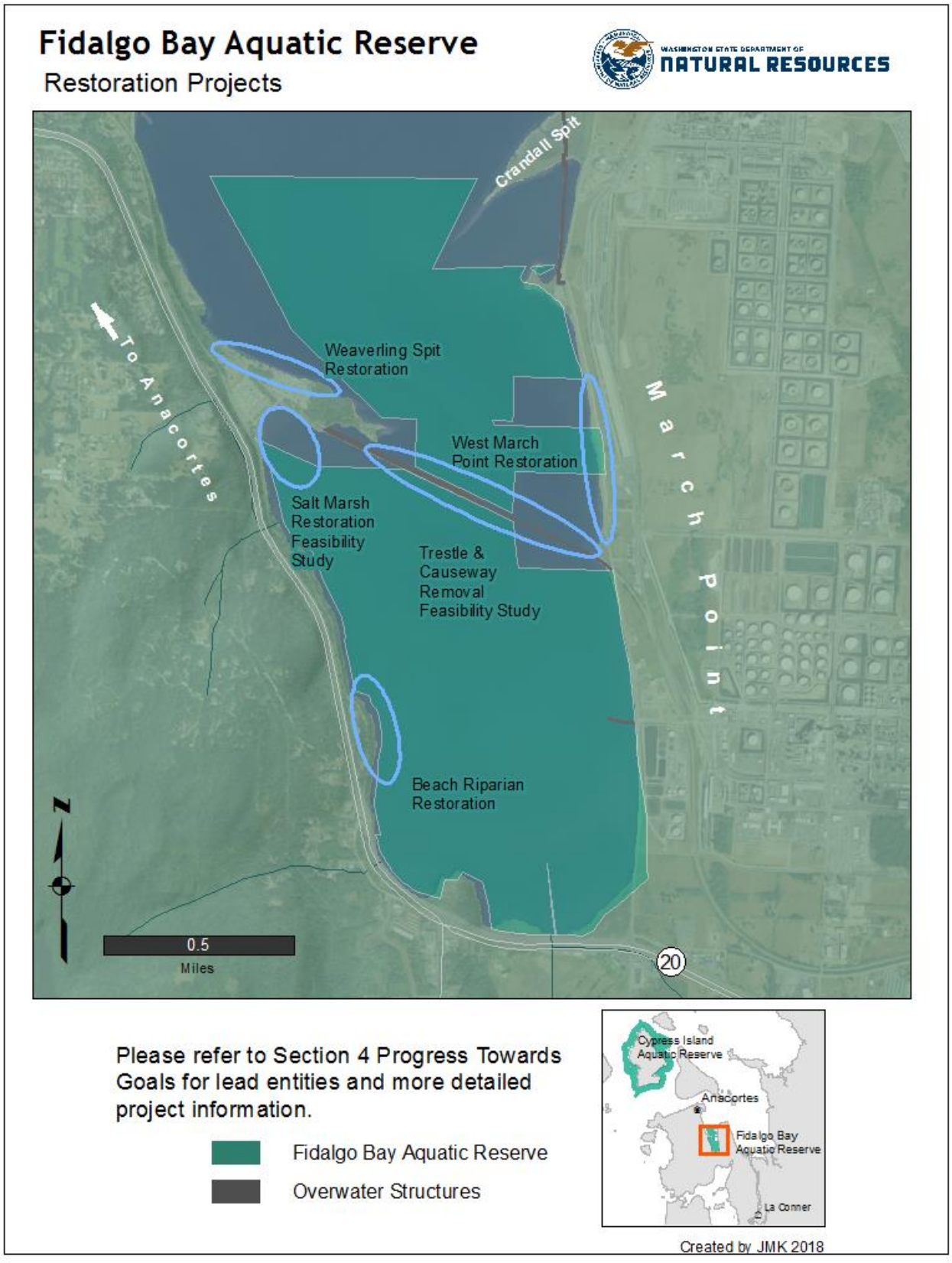


Map C–7: Littoral Drift Cells

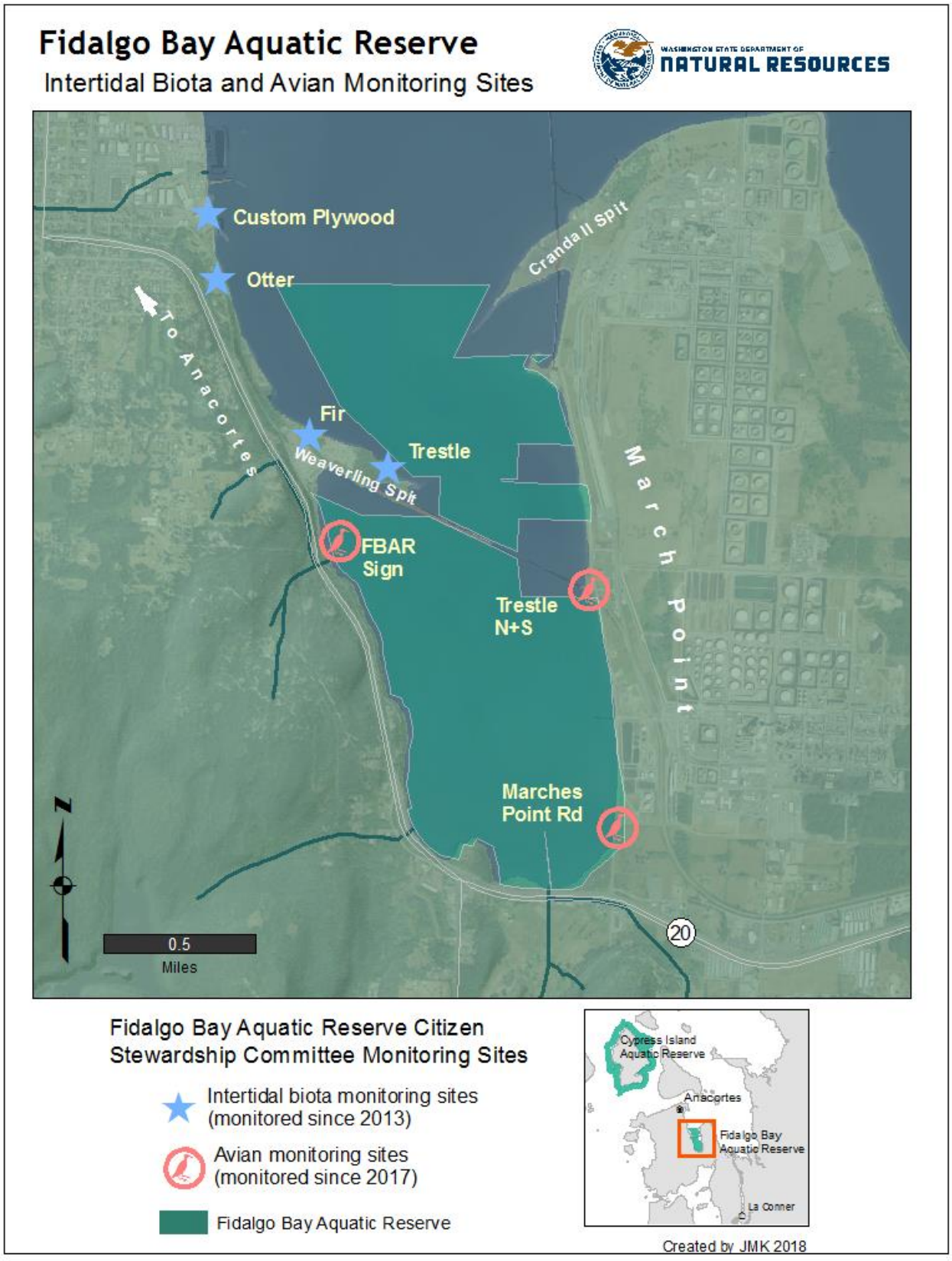
Map C–8: Eelgrass Distribution - 2016



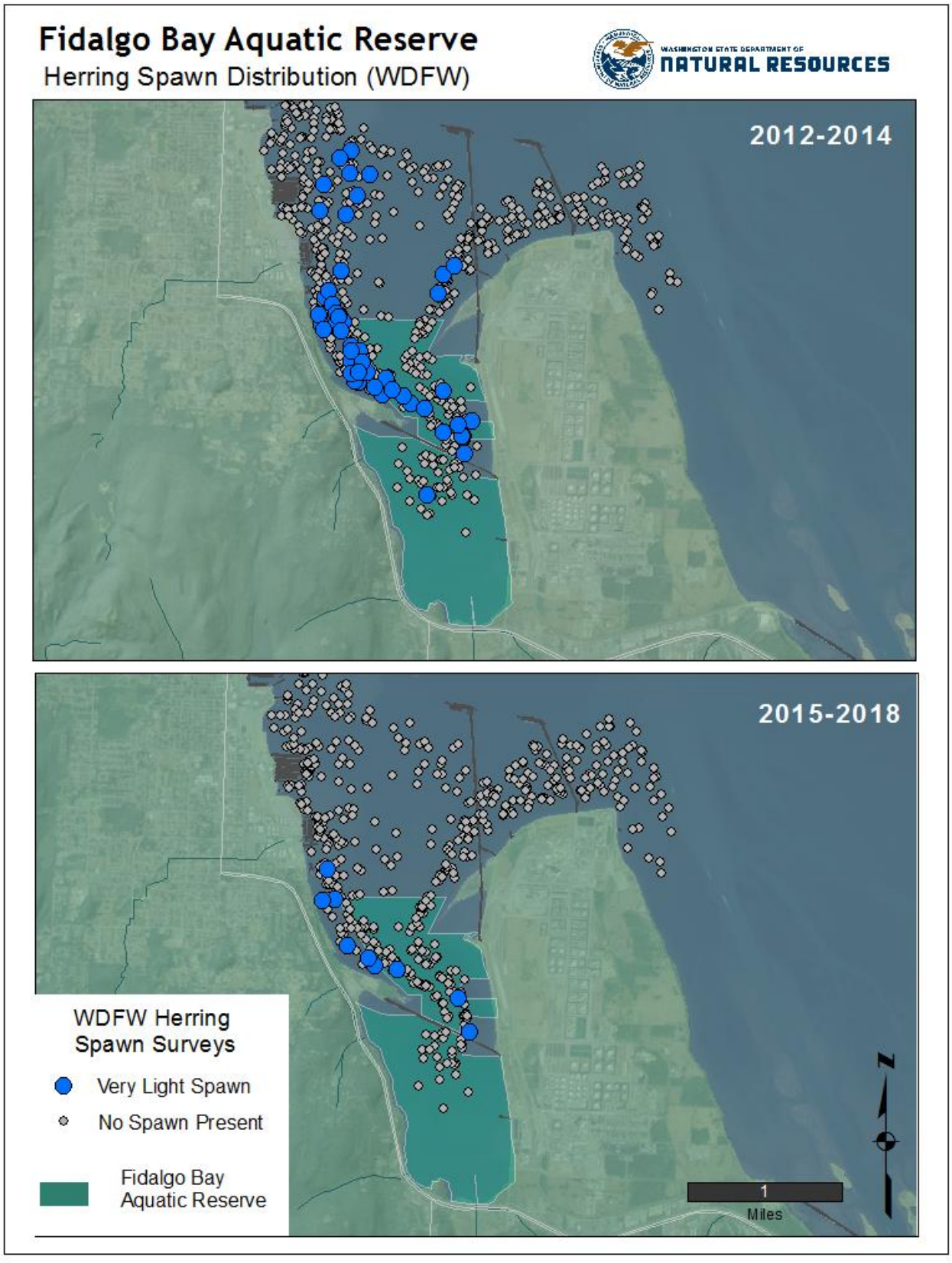
Map C–9: Restoration Projects



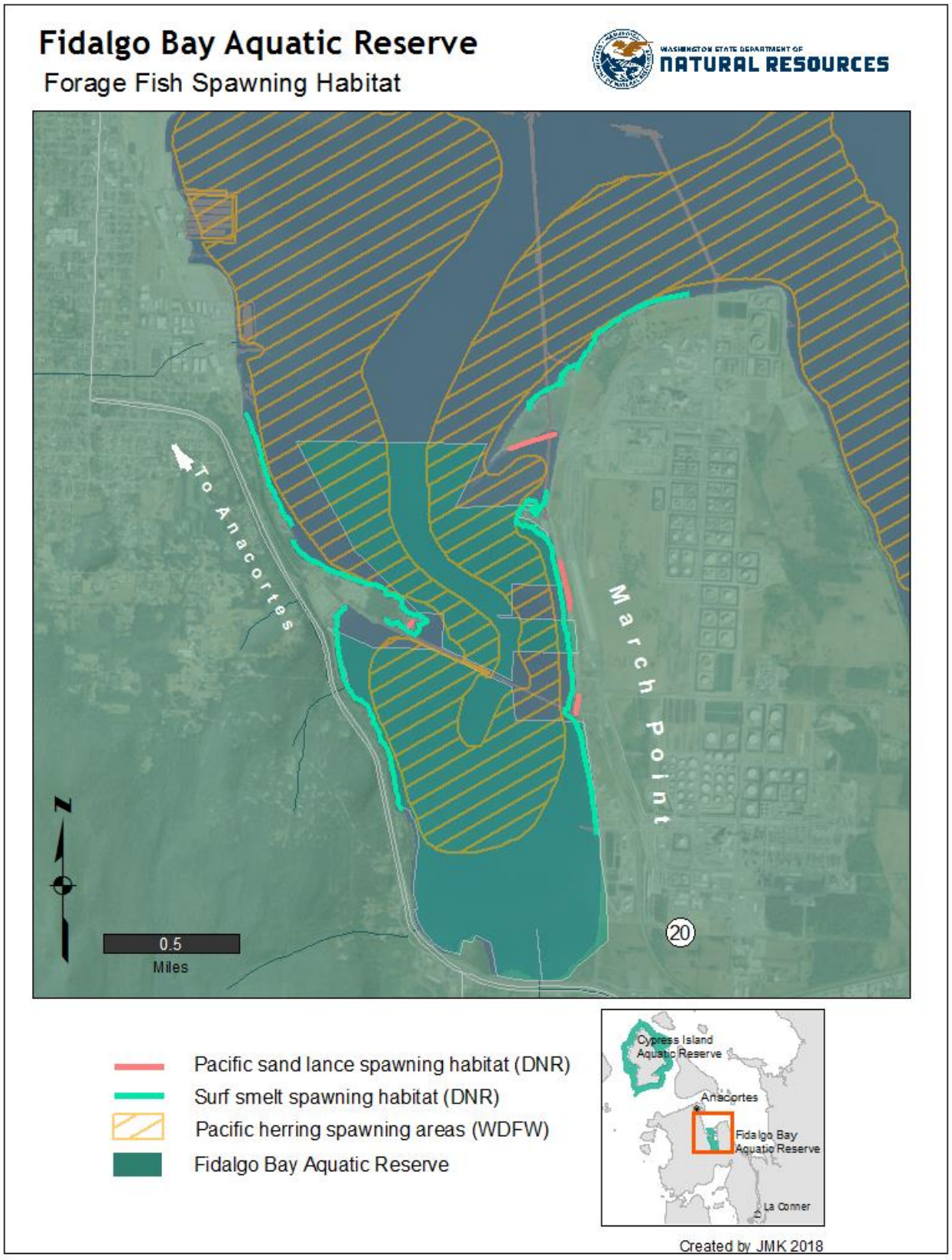
Map C–10: Intertidal Biota and Avian Monitoring Sites



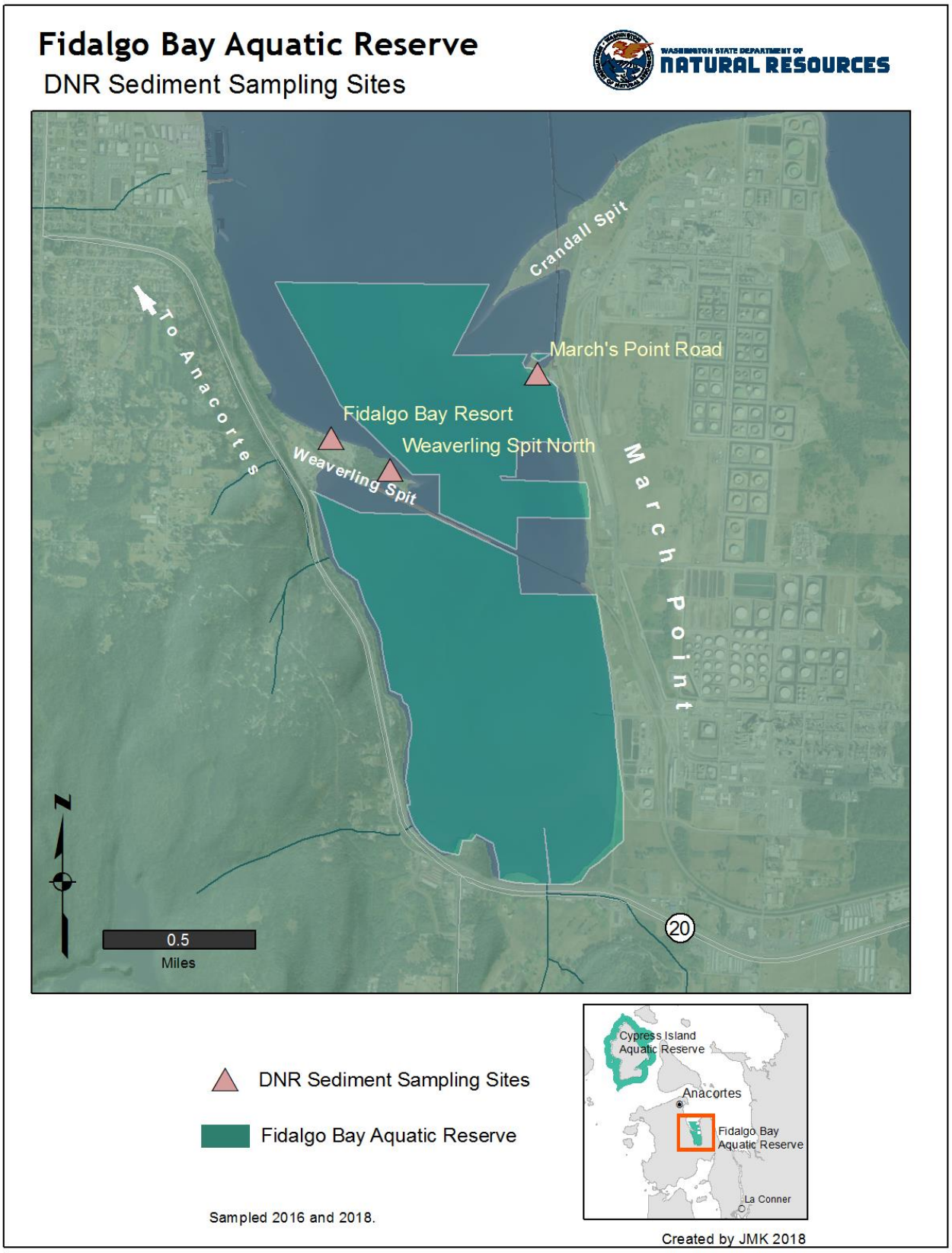
Map C–11: Herring Spawn Distribution



Map C–12: Forage Fish Spawning Habitat



Map C–13: DNR Sediment Sampling Sites



Appendix D – Two Year Work Plan (Implementation Priorities)

The implementation priorities listed below evolved from stakeholder meetings held in October 2018 and April 2019.

Plan Goal Supported	Recommended Strategy or Action	Lead(s)	Partners	Time frame	Notes
Goal 1: Protect enhance and restore natural processes	1.2 (b) Trestle and Causeway removal and replacement, planning and design (this was #1 priority from stakeholder meeting	City of Anacortes, DNR	Samish Indian Nation	2019-2021	Public support, funding, staff time required
	1.2 (f) Work cooperatively with adjacent landowners to identify habitat and conservation opportunities	DNR	Skagit Land Trust, Samish Indian Nation, Swinomish Tribe	2019-2021	Significant staff time
Goal 2: Conserve and enhance native habitats and species	2.5 (a) Water quality: coordinate with partners to identify and address sources of impairment	City of Anacortes, FBAR CSC, Samish Indian Nation	DNR	2019-2021	Coordinate with DNR sediment and water quality section
	2.1 (a) Identify and support enhancement and restoration projects that benefit reserve habitats	DNR	DNR restoration program, Ecology, other partners	2019-2021	Projects examples: marine debris removal, Olympia Oyster
Goal 3: Monitoring and research	3.4 (a) Develop management and tracking tool for strategy implementation	DNR	Request input from partners	2019-2020	This worksheet is the first draft

Plan Goal Supported	Recommended Strategy or Action	Lead(s)	Partners	Time frame	Notes
Goal 3: Monitoring and research	3.4 (b) support research that focuses on potential effects of climate change	DNR	Universities, research groups, agencies	2019-2021	Already supporting OA research
Goal 4: Education, Stewardship, and Partnerships	4.1 (a) Support the Fidalgo Bay Citizen Stewardship Committee, & partners carrying out education and outreach	DNR	ReSources for Sustainable Communities	2019-2021	Erica Bleke is dedicated staff for this
	4.2 (a) protect cultural resources, traditional uses; partner with tribes to promote public awareness of cultural values	DNR	Samish Indian Nation, Swinomish, other tribes	2019-2021	Consult on education, outreach projects

Appendix E – Commissioner's Withdrawal Order

200807

COMMISSIONER'S ORDER

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES

Doug Sutherland
Commissioner of Public Lands
Olympia, Washington 98504

WITHDRAWAL AND DESIGNATION ORDER FOR THE FIDALGO BAY ENVIRONMENTAL AQUATIC RESERVE

The State of Washington is owner of certain aquatic lands in Skagit County known as the Fidalgo Bay site consisting of tidelands and bedlands from the southern end of Fidalgo Bay north to a line drawn east and west from Crandall spit, hereafter described. Under statutory mandates, Washington's Department of Natural Resources (Department) manages state-owned aquatic lands and has found the following attributes that make the Fidalgo Bay site unique and critical for conservation:

Fidalgo Bay contains diverse physical habitats that include tidal flats, salt marshes, sand and gravel beaches, and expansive native eelgrass beds.

Fidalgo Bay serves as an important rearing area for juvenile forage fish and salmon and contains documented forage fish spawning beaches and salmon migratory corridors.

The connectivity of the reserve area to other nearby protected sites, including the Cypress Island Aquatic Reserve, Padilla Bay National Estuarine Research Reserve, and Hat Island Natural Resources Conservation Area, provide a network of critically important habitats for migratory shorebirds and waterfowl, bald eagle, peregrine falcon, salmon and forage fish.

Numerous opportunities for habitat restoration and enhancement exist within Fidalgo Bay and a diverse array of partner agencies and organizations are working cooperatively to improve the habitat in and around Fidalgo Bay.

Much of the tidelands in Fidalgo Bay are held in a conservation easement by the Skagit Land Trust, which limits future development on these properties. The management of Fidalgo Bay as a state aquatic reserve complements the requirements of the easement. The site will be managed solely for preservation of habitat for fish and wildlife uses and limited human uses.

A primary goal for creating the Fidalgo Bay Aquatic Reserve is the preservation of critical forage fish spawning habitat. Due to local losses in eelgrass and forage fish spawning sediment, and the uncertainty regarding factors limiting the Fidalgo Bay herring population, the protection of forage fish spawning habitat is a critical resource issue in Fidalgo Bay and statewide.

And

The Department is responsible for managing state-owned aquatic lands in a manner that includes:

Ensuring environmental protection as a management objective for state-owned aquatic lands (RCW 79.105.030(3)), and

Consideration of natural values of state-owned aquatic lands as wildlife habitat, natural area preserves, representative ecosystems or spawning areas prior to the Department issuing any lease or authorizing any changes in use (RCW 79.105.210(3)), and

Withholding from leasing lands which the Department finds to have significant natural values (RCW 79.105.210(3)).

Therefore, according to the powers vested in the office of Commissioner of Public Lands (RCW 79.105.030(3), RCW 79.10.210, and WAC 332-30-151), I, Doug Sutherland, hereby order and direct that Washington State tidelands and bedlands described below are withdrawn from the general leasing program and established as a state Environmental Aquatic Reserve.

LEGAL DESCRIPTION

That portion of the harbor area, waterways and beds of navigable water in Fidalgo Bay that are owned by the State of Washington in front of adjacent to or abutting Section 5, Township 34 North, Range 2 East, W.M. and in front of adjacent to or abutting Sections 29, 30, and 32 Township 35 North, Range 2 East, W.M. and further described as follows:

That portion of Fidalgo Bay lying southerly of a line beginning at the northeast corner of Tract No. 10 as shown on Plate 11 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 and said line extended easterly to terminate at the waterward terminus of the line between government lots 2 and 3 of Section 29, Township 35 North, Range 2 East, W.M.;

EXCEPTING THEREFROM, that portion of the southerly end of the West Arm of Fidalgo Waterway which was vacated by Waterway Vacation No. 101 according to the Commissioner's Order dated April 29, 1959 for Primary State Highway No. 1 (State Route 20);

ALSO EXCEPTING THEREFROM, that portion of the southerly end of the East Arm of Fidalgo Waterway granted to the Department of Highways as shown on State Road Plat No. 941 dated January 18, 1961 for Primary State Highway No. 1 (State Route 20);

ALSO EXCEPTING THEREFROM, that 100 foot right of way for railroad purposes across said Fidalgo Waterway granted to the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26;

TOGETHER WITH, those first class tidelands conveyed to the State of Washington according to the Statuary Warranty deed recorded on December 20, 1999 recorded under Auditor's File No. 199912200133, Skagit County Auditor's records and further described as follows:

Tracts 4, 5, 6, 7, 8, 9, and 10 of Plate 13; Tracts 8, 9, 10, 11, 12, 13, 14, and 15 of Plate 12; that portion of Tracts 16 and 17 of said Plate 12 and lying southerly of the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26; said tracts and plates are according to the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893;

EXCEPTING THEREFROM; that portion of said first class tidelands, if any, conveyed to the State of Washington for Primary State Highway No. 1, Jct. S.S.H. No. 1-D (State Route 20) by deed recorded October 15, 1956 under Skagit County Auditor's file No. 542873; by deed recorded January 3, 1958 under Skagit County Auditor's file No. 560284, and by deed recorded February 7, 1961 under Skagit County Auditor's file No. 603915;

ALSO EXCEPTING THEREFROM, that 100 foot right of way for railroad purposes across said first class tidelands granted to the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26;

TOGETHER WITH, those second class tidelands conveyed to the State of Washington according to the Statuary Warranty deed recorded on December 20, 1999 recorded under Auditor's File No. 199912200133, Skagit County Auditor's records and further described as follows:

All tide lands of the second class lying between the line of mean high tide and the line of extreme low tide, situate in front of and adjacent to, or abutting government lots 5 and 6, Section 32, Township 35 North, Range 2 East, W.M. and government lot 4, Section 4, Township 34 North, Range 2 East, W.M.;

ALSO TOGETHER WITH, tidelands of the second class, conveyed to the State of Washington according to the Statuary Warranty deed recorded on October 26, 2000 recorded under Auditor's File No. 200010260029, Skagit County Auditor's records and further described as follows:

Tidelands of the second class, extending from mean high tide to extreme low tide as conveyed by the State of Washington in deeds recorded in Volume 88 of Deeds, page 513 on May 21, 1912 and in Volume 102 of Deeds, page 550 on April 25, 1916 of Skagit County Auditor records, situate in front of, adjacent to, or abutting upon that portion of the government meander line described as follows:

Beginning at the northeast corner of Government Lot 1, Section 5, Township 34 North, Range 2 East, W.M.; thence South 28° West, 7.50 chains (495.00 feet); thence South 47° West, 17.50 chains (1155.00 feet) to the terminal point of this description.

Except that portion, if any, lying westerly of the easterly line of "East Arm Fidalgo Waterway" as shown on Plate No. 13, "Tide and Shore Lands in Section 5, Township 34 North, Range 2 East, W.M., Anacortes Harbor" as per the recorded plat thereof on file in the office of the Commissioner of Public lands, Olympia, WA.

ALSO Except that portion conveyed to the State of Washington for Primary State Highway No. 1, Jct. S.S.H. No. 1-D (State Route 20) by deed recorded January 10, 1961 under Skagit County Auditor's file No. 602917.

TOGETHER WITH, those bedlands, if any, lying westerly of the line of extreme low tide fronting and abutting the said second class tidelands situated in front of and adjacent to, or abutting government lots 5 and 6, Section 32, Township 35 North, Range 2 East, W.M. and government lot 4, Section 4, Township 34 North, Range 2 East, W.M.; and lying easterly of said east line of the East Arm of the Fidalgo Waterway;

TOGETHER WITH, those bedlands, if any, ling westerly of the line of extreme low tide fronting and abutting the second class tidelands situated in front of and adjacent to, or abutting government lot 7, Section 32, Township 35 North, Range 2 East, W.M. and lying easterly of the east line of said Fidalgo Waterway and the said east line of the East Arm of Fidalgo Waterway

EXCEPTING THEREFROM, that 100 foot right of way for railroad purposes across said bedlands, if any granted to the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26;

TOGETHER WITH, second class tidelands and bedlands, if any, lying northerly of the north lateral sideline of said second class tidelands in front of and adjacent to, or abutting government lot 7, Township 35 North, Range 2 East, W.M. and lying southerly of the south line of Tract No. 2 as shown on Plate 12 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893;

TOGETHER WITH, those bedlands, if any, lying westerly of the line of extreme low tide fronting and abutting the second class tidelands situated in front of and adjacent to, or abutting government lots 2, 3 and 4, Section 29, Township 35 North, Range 2 East, W.M. and the north 10.19 lineal chains along the meander line of government lot 8, Section 32, Township 35 North, Range 2 East, W.M. and lying easterly of the inner harbor line of the easterly most harbor area within Fidalgo Bay as shown on the Map of Anacortes Harbor as filed by the Harbor Line Commission dated 1892;

EXCEPTING THEREFROM; those bedlands, if any, of said Tract 2 as shown on Plate 12 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 as conveyed by the State of Washington according to the deed dated

April 17, 1908 within Volume 8 of Tide Land Deeds, page 370 on file in the office of the Commissioner of Public Lands;

ALSO EXCEPTING THEREFROM, those bedlands, if any, of Fidalgo Bay lying southerly of said line beginning at the northeast corner of Tract No. 10 as shown on Plate 11 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 and said line extended easterly to terminate at the meander corner between government lots 2 and 3 of Section 29, Township 35 North, Range 2 East, W.M.;

ALSO EXCEPTING THEREFROM; tidelands of the first class of said Tract 2 as shown on Plate 12 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 as conveyed by the State of Washington according to the deed dated April 17, 1908 within Volume 8 of Tide Land Deeds, page 370 on file in the office of the Commissioner of Public Lands;

TOGETHER WITH, parcels A, B, and C described in Statutory Warranty deed recorded October 27, 2006 Skagit County Auditor's file number 200610270168, described as follows:

PARCEL "A":

Tidelands of the second class lying within Tidelands shown as first class as Tract 2, "PLATE NO. 12, TIDE AND SHORELANDS OF SECTIONS 31 AND 32, TOWNSHIP 35 NORTH, RANGE 2 EAST, W.M., ANACORTES HARBOR", as shown on the official map of said Plate 12, in the office of the State Land Commissioner at Olympia, Washington.

TOGETHER WITH tidelands of the second class, if any, lying between the line of extreme low tide and the Westerly line of said Tract 2.

PARCEL "B":

Tidelands of the second class lying within Tidelands shown as first class as Tracts 5 and 6, "PLATE NO. 14, TIDE AND SHORELANDS OF SECTION 29, TOWNSHIP 35 NORTH, RANGE 2 EAST W.M., ANACORTES HARBOR", as shown on the official map of said Plate 14, in the office of the State Land Commissioner at Olympia, Washington.

TOGETHER WITH tidelands of the second class, if any, lying between the line of extreme low tide and the Westerly line of said Tract 6.

PARCEL "C":

That portion of first class tidelands shown as Tracts 16, 17 and 18, "PLATE NO. 12, ANACORTES TIDE AND SHORE LANDS", according to the map thereof on file in the office of the State Land Commissioner at Olympia, Washington, embraced within the following described boundaries, to-wit:

Beginning at a point on the North line of Tract 18, "PLATE NO. 12, ANACORTES TIDE AND SHORE LANDS", 650.8 feet South and 2,057.1 feet East of the section corner common to Sections 29, 30, 31 and 32, Township 35 North, Range 2 East, W.M.; thence East along said North line of Tract 18, 600 feet, more or less, to the East line of said Tract 18; thence Southerly along the Easterly lines of said Tract 18, 17 and 16, as follows, to-wit: South 28°36' East 790 feet; thence South 2°57' West 433.6 feet; thence South 14°22' West 10 feet, more or less, to the North line of the Great Northern Railway Company right-of-way; thence Northwesterly along said North line of the Great Northern Railway right-of-way 1,040 feet, more or less, to a point due South of the point of beginning; thence North to the point of beginning.

All of the above-described lands are situated in Skagit County, Washington.

And further, it is

ORDERED AND DIRECTED that the records of the Washington State Department of Natural Resources shall note that the property hereafter described possesses unique and significant natural values and shall be managed according to the Final Fidalgo Bay Aquatic Reserve Management Plan (April 29th, 2008) for 90-years from the date of signature of this Commissioner's Order.

This order hereby rescinds the Commissioner's Order concerning the tidelands and bedlands of Fidalgo Bay, dated May 26th, 2000.

Dated this 29th day of April, 2008.

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES

Doug Sutherland
Commissioner of Public Lands

Witness

Witness

Witness